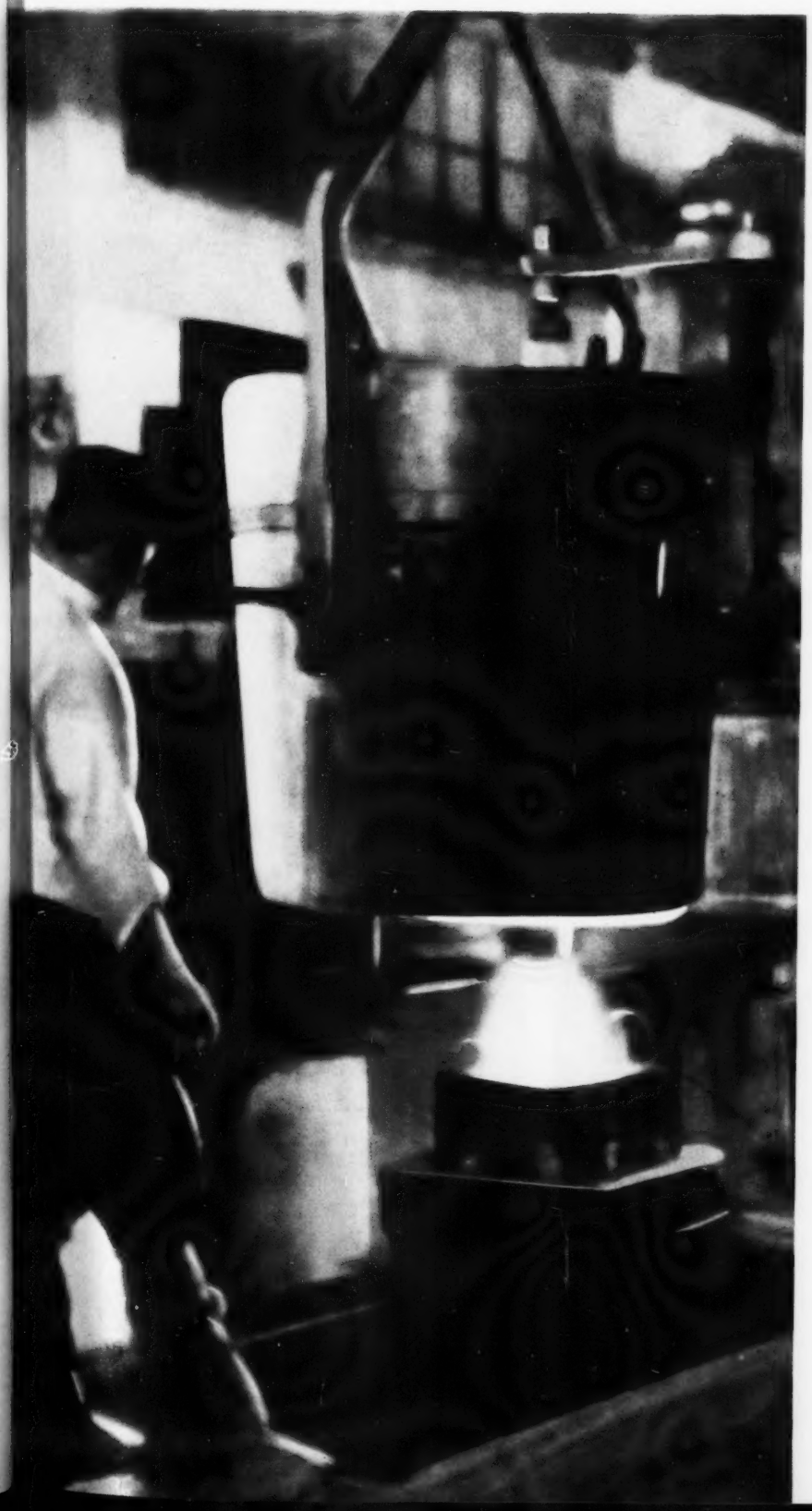
Engineering Library

ELECTRICAL WORLD

AUG 1 19



McGraw-Hill Publishing Company, Inc.

JULY 30, 1932

Twenty-five Cents Per Copy

New Induction Furnaces for Melting Alloy Steels

High-Power, High-Speed Locomotives for Swiss Railways

Effects of Ionization on Impregnated Paper Insulation

Practical Reductions in Distribution System Losses

How to Overcome Power System Instability

Industry Barometers Indicate Stability

KNOW your grounds — protect the lives of your men — make your electrical protective equipment safe against damage by using Murray Hollow Copper Ground Electrodes, which provide the most efficient and most economical way of keeping ground resistances at safe, permanent values.

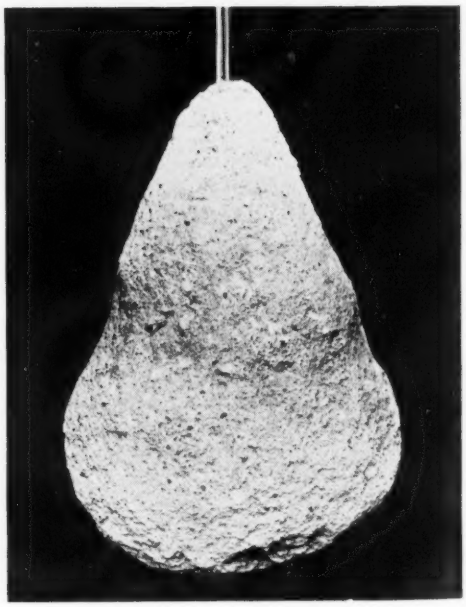
THE imbedding of treating solution the depth of the electrode means that immediate results are obtained and gives the assurance the precipitation and seasonal soil moisture variation will but slightly affect resistances thus regulated.

As the length of the electrode has been selected because of its relation to the permanent moisture level, the solution is where it gives the best results and where it will last the longest.

MURRAY lever clamp provides for external ground as well as for electrodes connected in multiple

MURRAY HOLLOW COPPER GROUND ELECTRODES

Have solved the ground resistance regulation problem



Extent and effect of treating as shown by laboratory experiment

METROPOLITAN DEVICE CORPORATION
1250 Atlantic Avenue, Brooklyn, N. Y.

Please send booklet describing MURRAY Hollow Copper Ground Electrodes.

NAME.....

Title.....

Company.....

Address.....

ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

July 30, 1932

Many Transit Contributions Bring Honor to Sprague

FRANK J. SPRAGUE, pioneer of the electric trolley, the electric elevator and many electrical safety appliances, was honored in New York on Tuesday of this week on his seventy-fifth birthday with a meeting of appreciation. Internationally known inventors, engineers, educators and industrialists participated in the tribute.

President Hoover, writing as an engineer, said in his tribute:

"My dear Mr. Sprague: I send you my cordial felicitations on your seventy-fifth birthday and all good wishes for the future.

"Your contributions in the development of the electric motor, followed by the application of electricity to street railway and to elevators link your name for all time with the distinguished group of inventors and engineers whose pioneer work made possible so many of our present utilities, comforts and conveniences.

"It is fitting that the engineering and scientific world should show general recognition of your noteworthy services to the electric art, and it is with regret that I find I shall not be able to be present at your anniversary celebration.

"Yours faithfully,

"HERBERT HOOVER."

Mr. Sprague's achievements include the first practical electric trolley at Richmond, Va., in 1887; the multiple-unit system now used in all subways and on many other electric railways; the first electric elevators, culminating in the modern dual system using two elevators in the same shaft, automatic remote control system for fire doors, banks, theatre curtains and many other purposes, and important features of modern electric railway signals.

The importance of Mr. Sprague's contributions to the rapid transit system was emphasized by Frank Hedley, president of the Interborough Rapid Transit Company. By his invention of the multiple-unit system of train operation, Mr. Hedley said Mr. Sprague had earned the right to be called "in addition to the 'Father of the Trolley Line,' 'The Father of Rapid Transit.'

"But he has not rested with the mere inventing or suggesting of new methods," Hedley continued, "he has recognized that the world is often too busy to pay attention to new and advanced ideas which are considered revolutionary, or to given them a trial unless forced to do so, and he has made it his business to do the necessary forcing. It is fortunate for the electric railway industry that he has made it his business to see that a new idea in which he had faith, was followed through the experimental stage and put into successful use.

"If I were called upon to name the most powerful influence contributed by Frank Sprague to the railway industry I think I should say it was his pioneering vision, supplemented by his fighting spirit."

Naval work also commended

Rear Admiral Samuel S. Robison, U. S. N. (Ret.), an old friend of the inventor, presented to him a set of volumes containing more than 500 autographed letters of congratulation received from all parts of the world, with photographs of the writers.

In his response, Mr. Sprague reviewed briefly his work in the electrical field and in conclusion "ventured a constructive prophecy." He pointed out that although other modes of transportation were becoming more important the railroad remained the "vital foundation of the country." "It would be folly to predict," he continued, "in the present low state of competitive traffic and world wide financial depression, that general electrification is advisable or even permissible in the near future, but if some of the hundreds of millions of capital which the national government is ready to dole out for unproductive public works were diverted to legitimate and sane electric railway equipment a long step would be taken toward economic recovery."

This Week

$70,000,000 in new financing eases Insull situation. p. 133

How ionization affects impregnated paper insulation. p. 152

Swiss railroad utilizes 8,300 hp. electric locomotive. p. 156

System stability gained by faster switching. p. 140

Re-employment plan launched in New England. p. 132

Six per cent called too high a yield for Rochester bonds. p. 131

Ontario makes an offer on Abitibi project. p. 134

Montreal Power Campaign Enters Last Phase

Montreal Light, Heat & Power Consolidated commenced mailing debentures to customer-subscribers July 15, the date of delivery originally planned. It is hoped to have all these debentures in the hands of subscribers by the end of the current month for all contracts.

which were fully paid up as of June 30. The debentures are for a term of seven years with interest at the rate of 3 per cent per annum, payable semi-annually on the first of January and July. They are dated July 1, 1932, and the capital is redeemable at full face value on any interest date from July 1, 1937, to July 1, 1939, at the option of the company, with privilege to the holder of converting each $50 debenture into one no-par-value common share up to July 1, 1937. In addition to giving them call on the stock (regardless of market price) during five years, these debentures assure subscribers the return of their money in full with interest.

For the comparatively small minority who have not completed installments due the company formally announces, as previously intimated, an extension of subscription contracts for six months from June 15 to December 15 (with interest adjusted at 3 per cent per annum), which, it is expected, will accommodate most subscribers in arrears.

▼

Capital to Get Power from Safe Harbor

Negotiations have been completed by the Potomac Electric Power Company through which hydro-electric power will be brought from the new plant on the Susquehanna River at Safe Harbor, Pa., to Washington, to supplement the supply generated by steam in the Potomac company's plants. A 23-mile transmission line will be built from Ellicott City to Washington.

The contract provides firm peak service interchange of hydro and steam energy with the Safe Harbor-Baltimore System. It will give Washington the advantage of an additional outside source of supply from a large and diversified power system, supplementing the local source of power in the District of Columbia. Provision is also made in the power agreement for coordinated system planning and operation of the generating and transmission facilities of the interconnected properties.

Construction of a switching station in Howard County, Maryland, the fabrication of the steel for the towers, installation of aluminum cables and the building of a 100,000-hp. transformer station, the laying of underground cables and work in several of the District substations are involved in the job. Construction will begin within the next few months and it is expected that the river power will be delivered to the Potomac system on or before October, 1933.

The Pennsylvania Railroad has contracted for power from this coordinated hydro and steam system for the electrification requirements of its lines from the Susquehanna Crossing at Havre de Grace, Md., to Washington.

Wisconsin Now Aims for Rural Rate Cuts

For the purpose of trying to work out informally a policy respecting rural electric rates in this emergency period, representatives of eleven utilities in Wisconsin serving approximately 25,000 rural customers, were called to Madison for a conference with the Public Service Commission last week. Commissioner Lilienthal pointed out that as the result of similar conferences during the last few weeks with officials of the Wisconsin Power & Light Company 9,000 rural customers of that company were given a $45,000 yearly reduction.

"This conference," said the commissioner's statement, "is in line with the commission's practice of trying to substitute conference and negotiation for time-consuming and expensive hearings, wherever possible."

Since the reorganization of the Public Service Commission a year ago approximately 419,392 customers of various types of utility service in the state, located in 244 communities, are now sharing in rate reductions totaling $2,349,802, which have been ordered or authorized by the commission during the last twelve months. Telephone reductions alone total $1,586,281, of which $1,550,066 is the 12½ per cent reduction which the commission has just ordered throughout the Wisconsin Telephone Company system, comprising 102 communities.

Electric light and power reductions in approximately 85 communities in all parts of the state total $497,596. Reductions for gas service total $214,625, benefiting about 11,975 consumers in four communities. Reductions in water rates total $51,300, and benefit about 30,000 consumers.

▼

Power Board Appoints Securities Examiner

Sanford H. Brown of Washington and New York has been appointed securities examiner by the Federal Power Commission. Chairman George Otis Smith of the commission said:

"This action is opportune by reason of the increasing attention which the reorganized commission is giving to the subject of the security issues of companies not regulated in this particular by state agencies."

Mr. Brown formerly was connected with the New York Stock Exchange's committee on stock list.

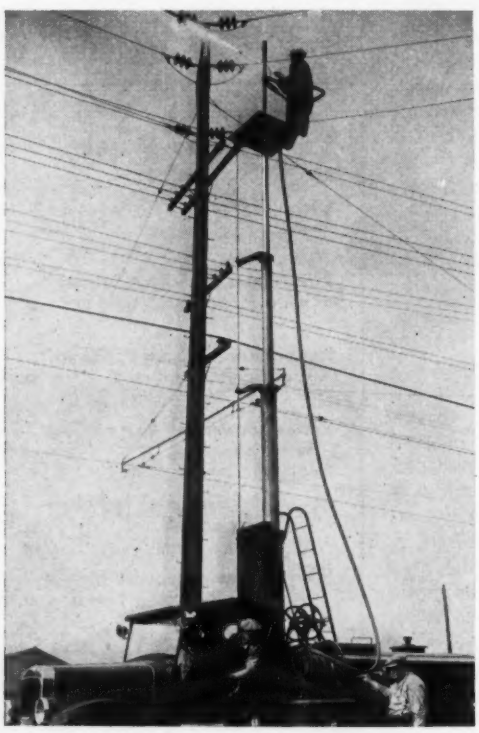
▼

Strikers and Unemployed Cut Cables in Carolina

Approximately 15,000 persons were thrown out of work in five North Carolina manufacturing centers after groups of strikers and unemployed toured about, cutting off electric power and either

▼ ▼ ▼

Insulator Maintenance Simplified in Los Angeles



Built to serve the dual purpose of a fire-fighting and insulator-maintenance truck for wood-pole lines this vehicle of the Department of Water and Power, Los Angeles, Calif., carries its own 650-gal. water supply, thereby eliminating delays in running hose lines or failure to function where city water mains have not been run, and a large chemical supply for use in live-line work. Uses include fighting brush fires and periodic cleaning of insulators. The 30-in. square platform may be raised hydraulically to a height of 30 ft. in about four seconds.

forcing or persuading workers to leave their posts. Nearly 150 miles were closed in High Point, Jamestown, Kernersville, Lexington and Thomasville. Approximately 6,000 workers left their posts in practically every manufacturing plant in the High Point area. It was estimated 100 major plants were closed, in addition to a number of smaller ones.

Every manufacturing plant in Thomasville, 6 miles from High Point, was closed and the invading groups spread their forces into Kernersville, Lexington and Jamestown, where other mills were shut down in rapid order.

▼

Maltbie Calls 6 per Cent High for Rochester Bonds

Criticism of the methods of financing the Rochester Gas & Electric Corporation was embodied in an opinion by the Public Service Commission supplementing the order issued last week, which made possible the refinancing of the company, but which provided that no dividends should be paid on the common stock until the discount paid by the company on an $8,500,000 bond issue shall have been amortized.

Chairman Milo R. Maltbie said that the sale of 5 per cent bonds, maturing in 30 years, at 85 per cent, meant that the funds obtained by this method would cost the Rochester corporation nearly 6.1 per cent annually, "an excessive rate for a well managed and well-operated company, even under present conditions.

"While this matter was under consideration the commission was informed that the old board of directors contemplated the declaration of a common stock dividend amounting to about $1,100,000 before the control of the company changed hands and before the order of the commission relating to these bonds was accepted. Immediately upon learning of this plan, the commission stated that it would not be permitted, as the Rochester Gas & Electric Corporation would be unable to comply with the terms of the contemplated order and also to pay a common stock dividend of $1,100,000. The company does not have sufficient funds to bo both."

Pennsylvania inquiry sought

In another area of Associated Gas & Electric System operations, Pennsylvania, three men who own 1,877 shares of the 6,000 shares of Metropolitan Edison stock not owned by Associated have asked the Public Service Commission to institute a widespread investigation of the financial operations of the company and of the Associated Gas & Electric Company. They want the commission to investigate the alleged intercompany securities transactions, the use to which proceeds of Metropolitan-Edison bond issues were put and the provisions of management contracts between the Metropolitan-Edison and the Associated Gas & Electric Company.

The stockholders also ask the commission to determine whether or not the working hours of employees are consumed in stock-selling campaigns.

▼

New River Case Advances to Constitutional Test

Without attempting to discuss the constitutionality of the federal water power act, United States Judge Luther B. Way, in Norfolk has overruled a motion by the Federal Power Commission to dismiss a suit in which the Appalachian Electric Power Company is asking for an order to restrain the commissioners from interfering with the construction and operation of a gigantic water-power project on the New River. The commission is expected to appeal the ruling.

The decision came after Newton D. Baker, appearing for the power company, had attacked the commission's order to the company not to construct the New River plant without a major license from the commission. Mr. Baker asserted that this action of the commission over a proposed project on a river which the commission itself had held to be non-navigable involved a "constitutional monstrosity" and "constitutional infirmities."

The State of Virginia has been allowed to intervene in the case and, like the power company, contends that the government is without jurisdiction because the stream is non-navigable.

Judge Way allowed counsel for the commission 90 days in which to appeal or file an amended bill.

The attack against the water-power act may not be ended until it has gone to the Supreme Court.

▼

Assessment Same as Rate Base Indiana Pleads

Both houses of the Indiana General Assembly have sent bills to second reading requiring the state Board of Tax Commissioners to assess utilities for taxation at an amount not less than that established by the Public Service Commission for rate-making purposes. Fourteen Representatives joined in introducing a bill permitting municipalities to establish their own utilities without interference of the Indiana Public Service Commission. This bill gives cities the right to issue bonds or other securities to pay for the erection, leasing or purchasing of utilities and permits the cost to be paid out of earnings, the debt to be paid within 30 years, and to bear not more than 6 per cent interest.

Psychological Reaction Brightens Week

PUBLIC CONFIDENCE, the restoration of which has long been regarded as the basic necessity for the beginning of better business conditions, appears to be showing demonstrable strength.

Security markets, sensitive to any reactions are responding under public and professional participation with increased volumes and better prices. Many commodities continue to show improvements of an encouraging and unspectacular nature. Car loadings as yet fail to show any marked response, indicating that production activities have not been affected.

After all, this is a presidential year; many strange things are foredoomed to happen. It is most encouraging to find that all-but-dispirited America is rallying for the turn. It is to be earnestly hoped that it may be called. A recent analysis shows that for some appreciable interval generally culminating shortly after the election that for the past fourteen or so presidential election years security markets have taken an upward step and business has appreciably speeded.

Likes Commonwealth Edison Appliance Financing Scheme

Lack of adequate financing facilities for small dealers is restricting the flow of merchandise today in retail channels throughout the country, says J. R. Bohnen, secretary of the American Washing Machine Manufacturers' Association.

That organization heartily indorses the plan of the Commonwealth Edison Company, Chicago, for helping the small dealer by affording financing facilities for his customers.

"Small dealers," says Mr. Bohnen, "find themselves today with many prospective buyers, but often they are unable to finance their installment sale paper. Local banks frequently will not or cannot accept this paper and the result is that a great many sales are, for that reason, lost."

▼

League Ads Not Operating Expense

The New York Public Service Commission has ordered the Central Hudson Gas & Electric Corporation to charge to surplus rather than to operating expenses all moneys which it has paid for advertising and other expenses of the Hudson Valley Electrical League, an association of electric contractors, jobbers and manufacturers interested in the electrical industry in the Central Hudson Valley. Payments of annual membership dues are excepted in the commission ruling.

Coming Meetings

Camp Co-operation XII—By boat to Bermuda, Aug. 3-8. Society for Electrical Development, 420 Lexington Ave., New York.

Wisconsin Utilities Association—Commercial section, Eau Claire, Wis., Aug. 25-26. John N. Cadby, 135 W. Wells St., Milwaukee, Wis.

American Institute of Electrical Engineers—Pacific Coast convention, Vancouver, B. C., Aug. 30-Sept. 2. Middle Eastern District Meeting, Baltimore, Md. Oct. 10-13. H. M. Henline, 33 West 39th St., New York.

Pennsylvania Electric Association—Bedford Springs, Pa., Sept. 7-9. H. A. Buch, Telegraph Bldg., Harrisburg.

Rocky Mountain Division, N.E.L.A.—Stanley Hotel, Estes Park, Colo., Sept. 12-14. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Empire State Gas & Electric Association—Saranac Inn, N. Y., Sept. 22 and 23. C. H. B. Chapin, Grand Central Terminal, New York.

Illuminating Engineering Society—New Ocean House, Swampscott, Mass., Sept. 26-30. E. H. Hobbie, 29 W. 39th St., New York.

National Electrical Wholesalers Association—Hotel Statler, Buffalo, N. Y., Sept. 26-30. E. Donald Tolles, 165 Broadway, New York.

National Safety Council—Washington, D. C., Oct. 3-7. W. H. Cameron, 20 N. Wacker Drive, Chicago.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Oct. 6-8. T. C. Polk, 20 N. Wacker Drive, Chicago.

Association of Electragists International—Kansas City, Mo., Oct. 10-12. L. W. Davis, 420 Lexington Ave., Nw York.

▼

Wisconsin Company Contests Telephone Rate Cut

Wisconsin Telephone Company on July 19th petitioned the state public service commission to secure the right to defend its position against the commission's order that the company reduce its rates 12½ per cent. The company was not given the right to offer evidence on its own behalf, and was not officially aware of the commission's intention to issue the order.

In the application the company cites forty-six reasons why the rate reduction order is "unreasonable and unlawful, confiscatory and unconstitutional." In addition the application charges nineteen "errors of fact and numerous erroneous conclusions." It is further asserted that the commission's order contained at least twelve inaccurate, untrue and incomplete statements which have been misleading to the public.

▼

Non-Profit Corporation Declared to Be a Utility

A corporation not for profit may be a public utility, Attorney-General Gilbert Bettman, of Ohio, has held in a ruling to the Ohio Tax Commission. The commission had directed an inquiry to the Attorney-General regarding a corporation which purchases electrical current from an electric power company through a master meter. The current secured from the power company is distributed among its members only, and through assessments it collects funds to pay for the current and maintain lines. An initiation fee of $5 is charged, members being charged with the cost of the current plus a pro rata share of the operating expenses.

Bettman held that a corporation not for profit is an entity separate and distinct from its members and that when it purchases electricity for consumption by an entity other than itself it is clearly a public utility.

▼

Reversion to Kerosene Cited in Move for Lower Rates

Thousands of North Carolina people who formerly used electricity for lighting their homes have gone back to the use of the old kerosene lamp because they are no longer able to pay rates charged by the power companies, according to Stanley Winnborne of the North Carolina State Corporation Commission, who argues that it would be good business for power companies to make rate reductions.

The State Corporation Commission has requested the power companies to submit statements, with full data as to rates, investments and earnings, this information being asked with a view to making a survey which may result in an order for downward revisions. Commissioner Winnborne reports the companies are co-operating with the state authorities to the fullest extent in assembling this information.

"This commission can only hold out to the public the assurance that it shall not be required to pay greater rates than justified," and the order cites examples of how the depression has hit utilities, including a loss of 4,000 subscribers in North Carolina by one telephone company.

▼

Re-employment Plan Launched in New England

Following an all-day conference at Boston last week upon the so-called New Hampshire plan of re-employment through shared time and wages which was attended by five governors, and some 100 leading economists, industrialists, educators and social workers, a resolution was passed inviting President Hoover to call a conference at Washington to further consider plans for restoring 3,000,000 workers to their jobs in business and industry. Last Saturday Mr. Hoover announced that he would welcome the opportunity to do this in the near future.

The New Hampshire plan was devised by Harold M. Davis, an industrial engineer of Nashua. In principle it provides that persons now employed above a minimum of four days per week shall be reduced to make room for others not now employed. It is the purpose to subdivide working hours so that every business unit can take on 10 per cent more persons than are now employed without increasing either operating expenses or plant investment. The money to pay the additional employees it is proposed to raise by contributions not exceeding 6 per cent of the present wages, the remainder to be made up by contributions by management and owners.

At the Boston meeting Dean W. B. Donham of the Harvard Graduate School of Business Administration questioned whether the plan would create the purchasing power desired by its advocates, but commended it as worthy of trial.

▼

Pioneering Commemorated by Paris Electrical Meet

Seventeen countries sent delegates to the International Congress of Electricity just held in Paris to commemorate the first international congress which met in the same city in 1881. The president of the French Republic, M. Lebrun, was in the chair at the official opening. His predecessor, the late M. Doumer, himself technically distinguished, had taken much interest in the planning of the congress and the large attendance was a tribute to his memory and interest in electrical development.

There were 60 present from this country and proportionate delegations from other countries. Germany, although not officially represented, also had 60 engineers and scientists present. This year's gathering listened to an extensive program of papers covering the whole electrical field and they constituted a remarkable index of progress made since the 1881 congress settled the basis of the volt, ampere and ohm and thus paved the way for an industry built on international conciseness of terminology and measurement.

▼

Occupation Tax Fought By Puget Sound Company

In a suit filed in superior court by the Puget Sound Power & Light Company, the new Seattle ordinance levying an occupation tax on public service corporations is branded as "discriminatory and arbitrary" in its failure to tax the city's municipally owned City Light plant. The suit seeks to invalidate the ordinance. This is the second court test aimed at the new ordinance, the Pacific Telephone & Telegraph Company having filed a similar suit recently, which is now pending.

$70,000,000 of New Financing Eases Insull Situation

WAY has been cleared for offering $70,000,000 of securities by Commonwealth Edison, People's Gas and Public Service Company of Northern Illinois since the Illinois Commerce Commission authorized the issuance of bonds for that amount. The entire $70,000,000 has been underwritten by a syndicate of four Chicago and four New York banks.

The task of raising $40,000,000 to meet obligations maturing at the end of this month and $10,000,000 for capital purposes is now accomplished as far as the three companies are concerned. Thus there is little further fear a number of the more speculative Insull holding and investing concerns will fall into receivership and seriously impair the credit of the soundly set-up operating companies in the Chicago district.

The underwriters have agreed to lend the three companies $40,000,000 to meet early maturities for a period not to exceed seven months and in turn have a five-month option on the financing to be done.

Under the amended order the Public Service Company of Northern Illinois received permission to sell $20,000,000 6½ per cent five-year sinking fund convertible gold bonds, dated July 1, 1932, and maturing on July 1, 1937, at a price not less than 92.

This company also was authorized to issue $20,000,000 6½ per cent twenty-year sinking fund gold bonds, dated July 1, 1932, and maturing on July 1, 1952, which are not to be issued concurrently with the $20,000,000 issue, at a minimum of 85. The company can also issue and sell at a minimum of 94 $11,900,000 of five-year 7 per cent gold debentures dated July 15, 1932. Of this issue $6,400,000 is to mature July 15, 1937, and $5,500,000 will be due on August 1, 1937.

According to present plans, Commonwealth Edison will buy $5,500,000 of these debentures. The Public Service Company, according to the commission's order, has the right to pledge any part of these bonds as security for short-term loans of one year or less.

Kentucky pays on preferred

The Kentucky Utilities Company, an Insull subsidiary, on July 18 declared its regular quarterly dividend of $1.75 per share on junior cumulative preferred stock, par $50.

At the meeting Edward H. Hurley and Charles A. McCulloch of Chicago, receivers for the Middle West Utilities Company, were placed on the board of the Kentucky Utilities Company. The Kentucky company did well last year. Troubles of the parent corporation have in no way affected the local company. It has not been enlarging or extending operations to any extent this year, it has needed credit only for current requirements and its cash position has been excellent.

The protective committee for holders of 5 per cent secured gold debentures of the National Electric Power Company is advising the owners of the obligations that they are confronted "with an exceedingly critical situation involving grave possibilities of loss of important assets, with dismemberment of the National Electric Power group of companies, and consequent impairment of the value of the remaining assets, including those consituting specific security for the debentures.

▼

Connecticut and Missouri Utilities Offer Bonds

New financing on the part of electric light and power companies, undertaken recently so successfully continues to feature the market. The Connecticut Light & Power Company has offered a $7,500,000 issue of first and refunding mortage 5 per cent sinking fund gold bonds at 95½ and interest, to yield 5.30 per cent. Proceeds of these bonds will provide for the payment of $1,000,000 maturing underlying bonds and of $4,290,000 floating debt incurred for additions and improvements, and will furnish funds for further additions and improvements. The electrical industry has evidently sensed with timeliness a receptive market for the securities of well-managed properties. Drexel & Company and Bonbright & Company announced that subscription books were closed at noon on the day of the public offering.

The Union Electric Light & Power Company (Missouri) made an offering of general mortgage gold bonds, 5 per cent series due 1957, the price being 94 and interest, yielding about 5.44 per cent. These bonds, dated April 1, 1932, mature April 1, 1957. Proceeds are to be applied to the reduction of unfunded debt of the company. The bonds are legal investment for savings banks and trustees in New York, Massachusetts, Connecticut and Rhode Island.

Bankers are reported to be conferring in Chicago in regard to public financing for the former "Big Three" Insull operating companies.

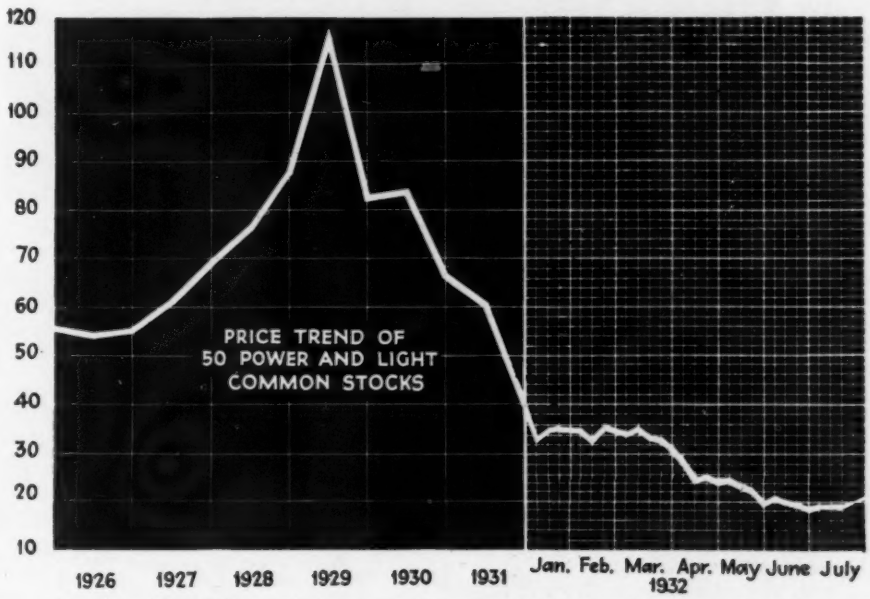
▼

Pinchot Utility Counsel Dropped

In the interest of economy, Governor Pinchot has dismissed his public utility counsel, John M. Walker, who drew a salary of $6,000 a year for helping the legislative committee which investigated the regulatory situation. He was also active in forming the Pennsylvania Fair Rate League.

▼

Stocks Move Upward



Stock prices followed the upward trend of the bond market, the list as a whole showing substantial gains. Utility stocks advanced in a wide range, the *Electrical World* index swinging up to 21.2, the highest point recorded since the middle of May.

Russia Quits Buying, but Keeps on Building

Amtorg purchases in the United States for the amount of the U.S.S.R. totaled $5,549,263 for the first half of 1932, a drop of 86.9 per cent from the 1930 level. Construction is going on apace, according to the *Economic Review of the Soviet Union,* as witness the following items:

Construction was started during the past few weeks on a number of large enterprises, including a central steam-electric station of 100,000 kw. capacity in Odessa. The Commissariat for Heavy Industry will start construction of an electrical and heavy machinery plant at Sverdlovsk to cost 420,000,000 rubles and employ 30,000.

The following electrical installations were put in operation: Three turbines at the Yaroslavl station of 11,000 kw. each; the Artemovsk station of the North Caucausus Coal Trust, with a capacity of 22,000 kw.; the second and third turbines of the Zuevka electrical station (Ukraine) with a capacity of 50,000 kw. each; one 50,000-kw. turbine at the Kashira station; a 24,000-kw. turbine at the Cheliabinsk plant; two 62,000-kw. turbines at the Dnieper hydro-electric station; one 24,000-kw. turbine at the Dzherzhinsk station, and the second turbine at the Second Leningrad station, with a capacity of 24,000 kw.

The fifth turbo-generator of the Dnieper River hydro-electric plant was assembled ahead of schedule and will be put in operation shortly.

▼

Ontario Makes Offer on Abitibi Project

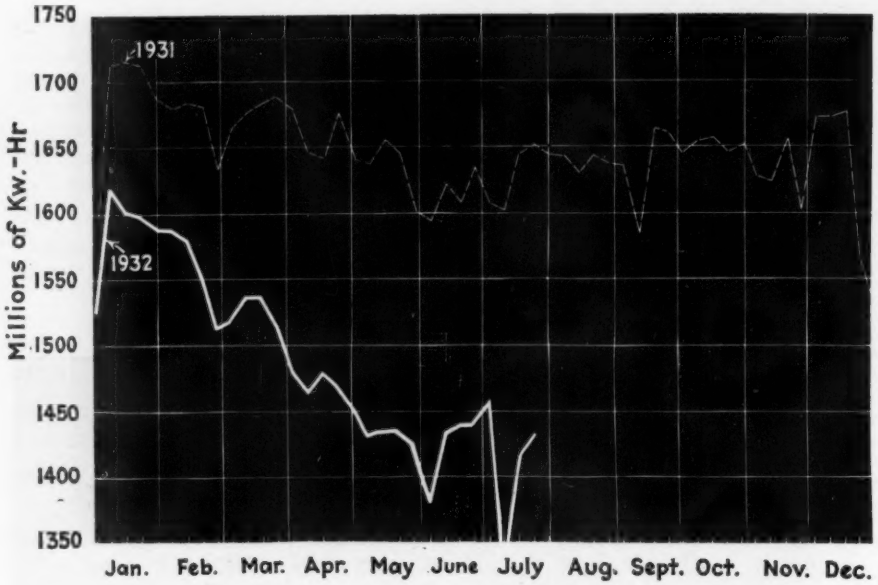
Premier Henry has issued a statement defining the policy of the Ontario Government in connection with the completion of the Abitibi power plant. He said in part: "The government and the Ontario Hydro Commission consider that it is most important that the Abitibi Canyon development should be completed, and the government, with the approval of the commission, finally decided as the most convenient way of getting title to the property to offer to the bondholders $18,000,000 of the commission's twenty-year debentures in exchange for the $20,000,000 of outstanding bonds of the company subject to the condition that 90 per cent of the issued bonds of the company are deposited in exchange. If a sufficient number of company bonds are exchanged, the commission will be able by necessary legal proceedings to acquire complete title to the property thereafter. It is intended that the commission will transfer the property to the Province, but will continue to manage it on behalf of the Province."

Within three months of the time when the big hydro-electric plant at Abitibi Canyon in northern Ontario was scheduled to be completed and in operation all work was shut down owing to financial difficulties. As announced in the July 9 issue of the ELECTRICAL WORLD, the Ontario Power Service Corporation, sponsor of the power project, has reached the limit of its financial resources, and the Ontario government, has been considering plans to take over the power scheme.

The plant proper is just about completed, while half of the machinery has been installed and the remainder is either on the ground or en route by train. Progress to date insured completion by October 1, when a large quantity of power was to be sent over the recently completed transmission line to the Sudbury nickel district, where low-grade mining awaits cheap power to make it profitable.

▼

Slight Gain in Weekly Output



DURING the week ending July 23 energy output of electric light and power plants continued on the upward grade, showing a slight increase compared with the preceding week, according to estimates announced by the National Electric Light Association on the basis of its weekly survey. The total for the week is given as 1,433,993,000 kw.-hr., 13.1 per cent below the corresponding week of last year, against 13.9 per cent a week ago.

With the exception of New England all the regional percentages show a slightly closer approach to last year's output than in the preceding week. New England showed a decline of 11.7 per cent compared with 1931 against 11.4 per cent during the week of July 16. This is the largest decrease reported in this region since the week of June 11.

Weekly Output, Millions of Kw.-Hr.

Week Ended	1932	1931	1930	1929
July 23	1,434	1,651	1,686	1,723
July 16	1,416	1,645	1,667	1,727
July 9	1,342	1,604	1,626	1,712
July 2	1,457	1,607	1,594	1,592
June 25	1,441	1,635	1,704	1,723

Per Cent Change from 1931

Region	Week Ended July 23	Week Ended July 16	2 Wks. July 9
Atlantic Seaboard	— 9.8	—10.3	— 9.4
New England alone	—11.7	—11.4	—10.2
Central industrial	—15.0	—16.1	—14.8
Pacific Coast	—15.9	—16.2	—13.9
United States	—13.1	—13.9	—12.8

A.S.M.E. Nominates Candidates for 1933

The nominating committee of the American Society of Mechanical Engineers has presented the following nominess for the offices of the Society for 1933:

President—A. A. Potter, dean schools of engineering, Purdue University, Lafayette, Ind.

Vice-Presidents — Harold V. Coes, management engineer, Ford, Bacon & Davis, Inc., New York, N. Y.; James D. Cunningham, president Republic Flow Meters Company, Chicago, Ill.; C. F. Hirshfeld, chief of research department, Detroit Edison Company, Detroit, Mich.

Managers—Robert L. Sackett, dean of engineering Pennsylvania State College, State College, Pa.; Alexander D. Bailey, superintendent generating stations, Commonwealth Edison Company, Chicago, Ill.; John A. Hunter, professor of mechanical engineering University of Colorado, Boulder, Colo.

Arrow-Hart & Hegeman Ordered to Dissolve

Three months is allowed the Arrow-Hart & Hegeman Electric Company of Hartford, Conn., by the Federal Trade Commission, to divest itself of the common stock, plant and equipment of either the Hart & Hegeman Manufacturing Company or the Arrow Electric Company. The order, based on section 7 of the Clayton Act, indicates that the existing combination tends to create a monopoly in the electric wiring devices industry.

Chairman W. E. Humphrey dissented vigorously from the decision, doubting whether the commission has the power to make such an order and not agreeing that existing structure lessened competition to such an extent as to injuriousy affect the public.

The ruling holds that the combination now existing restrains interstate commerce in the regions where the two component producing units operate. The original complaint was filed in 1928 against Arrow-Hart & Hegeman, Inc. Subsequently the two separate holding companies to which Arrow Electric and Hart & Hegeman Manufacturing Company stocks were transferred merged to form the corporation which the commission now orders dissolved.

▼

Allis-Chalmers Net Loss $1,805,898 for Six Months

Allis-Chalmers Manufacturing Company's report for the six months of 1932 shows a net loss, after all charges including interest on debentures and depreciation, of $1,805,898, ($936,395 in the first quarter and $869,503 in the second quarter), compared with a net profit of $1,006,061 for corresponding period a year ago. Billings for the current six months were $7,315,072 as against $16,195,269 in 1931.

Bookings for the six months of 1932 amounted to $6,561,826 contrasted with $12,224,877 in like 1931 period. Unfilled orders June 30, 1932, aggregated $7,136,087 and $7,889,334 at the close of 1931.

The balance sheet on June 30 discloses net current assets of $26,615,693.

▼

Hubbard Takes Ohio Brass Hardware Line

Ohio Brass Company, Mansfield, Ohio, announces that it has disposed of its line of wood cross-arm hardware, wood guy-strain insulators and steel insulator pins to Hubbard and Company, Pittsburgh, Pa. The latter company is licensed to manufacture and sell pole line hardware developed by Ohio Brass and protected by its patents. This is a manufacturing and sales arrangement only, and there is no financial interest of either company in the other. These materials, in the future, will be manufactured only by Hubbard and Company, although both companies will cooperate in the sale of the devices. Future development work on this class of materials also will be carried forward by both companies. Due to the specialized manufacture and engineering of similar materials by Hubbard, both companies expect that users will benefit by this cooperative arrangement.

▼

Japanese Copper Forces New Low Price

Unsettlement in the world copper markets due to the confused outlook for a British Empire tariff and the apportionment of world markets as a result of that and the new domestic tariff, as well as to the continued existence of heavy stocks of metal, again forced down prices. A new low for copper was reported when the Japanese quotation was dropped to 4.50 cents a pound, while Copper Exporters, Inc., reduced the special offering price to 4.70 cents a pound for delivery abroad.

The domestic price for copper was held at 5¼ cents a pound, more than ½ cent above the world market price. This is the largest differential to exist since the imposition a month ago of a 4 cent a pound duty on imports of copper into the United States.

Anaconda and Katanga are reported to have reached an accord.

▼

Buyers Volunteer Larger Payments on Kelvinators

"There are two very reassuring facts in connection with the electric refrigeration business in this year 1932," states Charles M. Armstrong, vice-president and general manager of the Refrigeration Discount Corporation, the subsidiary of Kelvinator Corporation handling consumer paper. He continued:

"Despite greatly increased sales of Kelvinator and Leonard refrigerators this year, our records show a very small number of repossessions and the down payments represent an increasingly high percentage of the total purchase price. This increase in the amount of the down payment has been altogether voluntary on the part of the purchaser as there has been no upward change in our down-payment demands."

Mr. Armstrong also states that collections are very satisfactory and delinquencies are at as low a point as at any time in the last three years.

Major New Construction This Week

TRANSFORMERS and transformer room equipment, electric-operated pumping machinery, machine drives, heavy duty motors and controls, panelboards and other electrical equipment will be required for new oil refining plant of Globe Oil & Refining Company, at McPherson, Kan. A $1,000,000 project.

Surveys authorized by Current River Power Company, Doniphan, Mo., for hydroelectric power project, for which Federal permit has been granted, to consist of three power dams and generating stations with gross initial capacity of 26,000-hp. Project will include transmission line. Estimated cost over $650,000.

Until August 10, bids are asked by Department of Sanitation, New York, for three incinerator plants in different parts of city, with transformers, heavy duty motors and controls, electric-operating conveying machinery, elevating and loading machinery, and other electrical equipment. Each unit estimated to cost $962,000, total project $2,886,000.

Steel tower transmission line, 23 miles long, is planned by Potomac Electric Power Company, Washington, D. C., from Ellicott City, Md., to Washington, connecting with Safe Harbor Water Power Company; project will include a large switching station in Howard County, Md., to handle 230,000-volt lines, new 100,000-hp. power substation in vicinity of Washington and extensions in several present substations, with installation of underground transmission lines in part of city. Cost over $350,000. Work follows expansion program of company now under way on steam-electric generating plant of 35,000-kw. initial capacity at Buzzard's Point, junction of Potomac and Anacostia Rivers, cost estimated at $4,000,000.

Final Results of Westinghouse Campaign

Complete reports on the volunteer sales campaign of 35,000 employees of the Westinghouse Electric & Manufacturing Company during May and June show a grand total of $2,600,000 in sales. Of this total, $1,500,000 was reported for May and $1,100,000 for June. While no cash goal was set, these figures are said to exceed the most optimistic hopes of the leaders in the crusade.

▼

New York Metal Prices

	July 19, 1932 Cents per Pound	July 27, 1932 Cents per Pound
Copper, electrolytic	5.25	5.25
Lead, Am. S. & R. price	2.65	2.80
Antimony	5.00	5.00
Nickel, ingot	35.00	35.00
Zinc, spots	2.85	2.85
Tin, Straits	20.875	21.05
Aluminum, 99 per cent.	23.30	23.30

Uncollectable Accounts Increase Sixfold in Detroit

In opposition to Detroit's application for decrease in electric rates, H. A. Snow, controller for the Detroit Edison Company, today introduced eighteen exhibits in support of the company's claims that present rates are not excessive.

The exhibits showed that while coal costs have not decreased to any great extent, and taxes have increased the firm's business has declined $5,000,000 annually in the last two years. Mr. Snow testified that uncollected bills totaling $600,000 will be written off this year. The loss written off in June was $58,000, in comparison to $10,000 in June, 1929, he said.

▼

Fair Will Have All-Electric Home

The home of the future, built of new synthetic materials, air-conditioned and humidified, fitted out with the latest labor-saving equipment, utilizing every foot of space, including the roof for the comfort of its occupants, decorated, furnished and illuminated in modern fashion will be demonstrated at Chicago's 1933 World's Fair.

▼

Dayton Lowers Commercial Rate

Dayton Power & Light Company, subsidiary of the Columbia Gas & Electric Company, has reduced its commercial rates. The new rates are 7½ cents each for the first 50 kw.-hr.; second 50, 7 cents; next 100, 5½ cents and 300 to 500, 5 cents, and all over, 4 cents. Former rates were first 30 kw., 9 cents each; next 100, 7 cents; and all over 130, 5 cents. The new rates do not include the 3 per cent federal excise tax.

▼

Carolina Power Tax Stands

The validity of South Carolina's tax on power was upheld in an opinion by a three-judge Federal court filed at Columbia last week and applications for a permanent injunction against its collection were denied.

▼

Municipal Resurrects Generator

Columbus, Ind., is overhauling a turbogenerator to be used for the street-lighting system. The set had been idle for twelve years and was reported in excellent condition in spite of its long disuse. When this unit is placed in operation the city will discontinue purchasing power from the Public Service Company of Indiana.

▼

Asks Release from Flood Damage

Alabama Power Company has filed motion in Jefferson Circuit Court to set aside a verdict awarding $185,000 to the Bosworth Smith contracting firm for damages alleged to have resulted from opening a floodgate at Lock 18. The motion will be heard August 5. Bosworth Smith company claimed a $250,000 loss when the gate was raised, unloosing a wall of water which swept away a cofferdam and barge used in constructing a bridge below the dam at Wetumpka.

▼

Couzens Indorses Board's Proposal

The recommendation of the Power Commission for full federal regulation of electric utility holding companies was indorsed by Chairman Couzens of the Senate interstate commerce committee. Couzens said he wanted law for the purpose enacted at the next session of Congress, together with legislation controlling interstate power transmission.

▼

More Clocks to Watch

Contracts for 2,650 synchronous electric clocks for three new federal buildings have just been awarded to the Warren Telechron Company, of Ashland, Mass. Approximately 1,100 clocks will be installed in the Department of Justice Building, 1,100 in the Interstate Commerce Commission and Department of Labor buildings and 450 in the Postoffice Department Building. The recent installation of 875 telechron clocks in the Bureau of Internal Revenue Building is said to be one of the largest in the world.

▼

Plymouth Indiana Gets Reduction

An interlocutory order setting up a new schedule of temporary optional electrical rates in Plymouth and ordering an audit and appraisal of the Northern Indiana Public Service Company property affecting the company's service in Plymouth has been issued by the Indiana Public Service Commission. The order, written by Howell Ellis, commissioner, and concurred in by all the commission members, pointed out that testimony at hearings on the city's petition for lower rates revealed that rates in Plymouth are excessive and unreasonable.

▼

Baltimore Asks Lower Rate

The City Council of Baltimore has passed a resolution requesting the Consolidated Gas, Electric Light & Power Company to reduce its rates on electricity and gas, and also asking the Chesapeake & Potomac Telephone Company to reduce its rates. There was considerable opposition to the resolution. Those favoring the resolution claimed that the present rates were fixed some years ago when prices were higher.

Conference Replaces Convention

A two-day executive conference at French Lick on October 6 and 7, instead of the annual convention, was decided upon by the executive committee, Great Lakes Division, N.E.L.A., at a meeting in Chicago on July 15. Business building, market development and personnel matters will be the themes in the business sessions, which will take the form of round-table discussions, presided over by President S. B. Way.

▼

Potomac Edison Building New Steam Station

The Stone & Webster Engineering Corporation has closed a general contract to furnish the Potomac Electric Power Company, Washington, D. C., consulting, engineering and construction service, it has been learned here. Under this contract work is now in progress on the design and construction of a new steam power station at Buzzard's Point, the junction of the Anacostia and Potomac rivers. The Potomac Electric Company will spend approximately $4,000,000 on this work. The new station will deliver power by October 1, 1933.

▼

Offices Moved to Ohio

Ohio Electric Power Company, which controls 27 subsidiary companies supplying power to central and western Ohio, has established headquarters at Marion, Ohio, under M. J. O'Connell, executive vice-president. The main offices of the concern, a Middle West Utilities Corporation unit, formerly were located at Sidney, Ohio, and Altoona, Pa. The decision to transfer headquarters to Marion was made following purchase of the Columbus, Delaware & Marion Electric Company.

▼

Board Faces Municipal Reduction

The city of Logansport, Ind., has been given permission by the Indiana public service commission to file a reduced light rate scale for commercial and residence patrons. The commission last year had ordered decreases which were opposed by the municipal plant. A Supreme Court decision upheld the commission to establish municipal plant rates.

▼

Calgary Acquires Ottawa Utility

Control of the Ottawa Valley Power Company, formed in 1930 to develop a hydro site at Chats Falls on the Ottawa River in conjunction with the Hydro-Electric Commission of Ontario, has been acquired by the Calgary Power Company.

New Tool Helps Duct Building and Repairs

Ducts can be cleared of even concrete obstructions, the bores can be enlarged and earth drilled for horizontal duct runs by a new tool demonstrated to utility men in New York City last week by Boring & Drilling Corp. The utility men saw its greatest field in simultaneously rodding and threading ducts, installing ducts where it is impracticable or uneconomical to excavate and clearing silt from flooded conduit.

The ELECTRICAL WORLD representative present timed the passage of the tool through two concrete plugs 9 in. long at 48 seconds, a rate of 2 ft. per minute. The cutting head is air driven at 5,000 to 10,000 r.p.m. and is supplied with air through articulated Shelby tubes 3 to 5 ft. long, the joints of which are air-tight, but can be quickly connected or disconnected.

A bore through 12 ft. of undisturbed earth was made in 4 seconds and came out practically at the predetermined point even though it encountered tree roots which would have made excavation difficult.

▼

Welding the New Ford is Fully Mechanized

Electric welding has been highly mechanized in the fabrication of the new Ford V-8. Special machines have been developed for quantity production. Butt flash welding of the body sections, high-speed resistance seam welding under the automatic control of photo-electric tubes, machine spot welding under automatic hydraulic manipulation and advanced arc welding are examples. So-called bar and gun welding have been evolved to expedite spot-welding of assemblies. It is said that there are at least 2,000 welds in a single car.

▼

Hydro Plant Resumes After Fissure Stopped It

Water from the headrace again flows over the spillway and waterfall of the Arapuni hydro development in New Zealand, after an interval of nearly two years. In June, 1930, a fracture occurred in the terrain between the headrace and the power house. Hydrostatic pressure developed in the fissure, causing it to extend, and the whole body of rock, including the power house, tilted slightly toward the river gorge. Extensive remedial measures have since been carried out by the New Zealand Public Works Department. The output of the three generators at present installed is 45,000 kw., which will be increased to 60,000 kw. when the installation of the fourth unit is completed.

▼

Two Utilities Set Safety Records

An all-time safety record for the Philadelphia Electric Company's more than 7,000 employees was made during the 33 days ended July 10. During the period, which amounted to 1,700,000 working hours there was neither a lost-time accident nor a fatality.

A record of "perfect safety" was also established by approximately 4,000 employees of the Georgia Power Company, for the first time in the history of the company in June, 1832, a goal toward which the company has been working since the inauguration of a program of safety education in 1925. This program has reduced the number of "lost-time" accidents from 624 in 1924 to only 59 in 1931. So far this year only fifteen lost-time accidents have been registered.

▼

Invisible Light Improves Visibility

Invisible light is being used to improve visibility for pilot and motorist, thanks to J. H. Kurlander, engineer of the Westinghouse Lamp Company. Looking away from the intense illumination of an instrument board and gazing through the darkness for ground signals along an airway disturbs the pilot's vision. Driving at night, motorists experience the same difficulty when they look at the gages and then at the road ahead. In both instances the condition is objectionable, even dangerous.

So Mr. Kurlander gives the instrument dials a coating of luminous radium paint and then accentuates their visibility by illuminating them with invisible violet light rays. This makes it possible for pilot or motorist to read all instruments at a glance without being momentarily blinded by the glow from artificially lighted equipment. Test installations at the Newark airport have demonstrated the definite practical value of this new use of invisible light.

▼ ▼ ▼

QUADRUPLING LIGHT AIDS SPEED AND SAFETY IN NOTED PART OF "HUB"

A 400 per cent increase in street lighting has been provided in Boston for traffic highways along the Charles River Embankment in the hospital district at the foot of Beacon Hill. The work included installation of 1,500-cp. and 1,000-cp. 20-amp. lamps in place of the 6.6-amp. units which formerly lighted the region.

EDITORIALS

L.W.W.MORROW
Editor

A yardstick needed for reserves

SINKING fund, straight-line and retirement experience theories and practices as to depreciation reserves all have their advocates. Diversity of opinion is helpful in formative periods, but there usually comes a time when the spread of diversity must give way to the unity of a common agreement. That time is rapidly approaching for the utilities now that two commissions have ordered halting of dividend payments until it has been demonstrated that the security of the local operating properties is properly safeguarded, including the provision of adequate reserves. These commissions have made an issue of reserves. It should be settled soon by a joint, exhaustive and authoritative analysis.

Such a study will have to take into account the radical difference between the small enterprise which appears to need relatively large reserves to meet the accrual of retirement in its larger units and the large enterprise for which not even the largest unit is large in relation to the system. It will have to consider the uncertain and intangible element of obsolescence due to technical advances. It cannot ignore the past rate reduction penalties imposed upon companies which kept operating expense low by a greater share of retirement costs carried as a reinvested capital account.

The electrical industry has been going long enough to provide the necessary data for supporting a unified practice as to depreciation and retirement reserves. It and those who regulate it should now be in a position to know what weight should be given to all elements in arriving at a simple and adequate reserve-building practice to carry the properties through any kind of business era. If this is not done soon it will be an unending point of contention and the source of many possibly harmful rulings based upon an extension into other states of the legislative rights of the commissions to check the disbursement of earnings on the ground of conserving corporate stability of the operating companies.

Closing the gap between construction and operation

SYSTEMATIC inspection procedure must be organized and established to preserve continuity of high-grade plant performance while administrative responsibility passes from construction to operating control. The amount of detail which has to be handled in tuning up important installations and lines is surprising. The present period of low construction pressure affords many companies a valuable opportunity to study past experience in staff and equipment coordination during the later stages of construction, the time of preliminary operation and that of routine service. From these studies it may be feasible to assemble under one or more covers the plans made and carried out for testing important items at the factory and in the field singly and in groups; to list numerous problems encountered and attacked in the zone of advance to commercial operation; to investigate job calendar and progress sheets from the standpoint of difficulties brought to light at particular times, and to anticipate inspection and maintenance procedure in enough detail to avoid ragged operation as the installations of the future take their place.

More and more exhaustive cost data are being assembled from the field sheets of major undertakings for future use in estimating, capitalization and rate cases. In like manner, procedure records may well be prepared from project experience so that in future work of similar kind it will be unnecessary to trust to memory in trying to organize

the steps required to insure continuity of equipment service in the earlier days of operation. No two undertakings may be alike, but the underlying channels of procedure in passing from one stage to the other should be clearly defined in closing gaps between administrative authorities.

Ionization in cables

PERHAPS one of the most important and at the same time least understood properties of high-voltage insulation is that of permanence or stability. A distinguishing feature of dielectrics and insulation as compared with conductors is the perfect stability of the latter in carrying current, and almost invariably a continuous process of change in the former when subjected to electric stress, particularly if the stress is alternating. It is exceedingly difficult to follow these changes in insulation. About the only available method is that of the measurement of the so-called power factor or phase difference of the body of the insulation, and particularly its increase with increasing voltage. Increase of power factor with voltage means a loss component of current increasing more rapidly than in proportion to voltage. This under any theory of dielectric behavior readily yields a picture of some type of internal structural change. For example, a current increasing more than in proportion to voltage immediately suggests the generation internally of new ions by collision, and this can only happen as the result of molecular breakdown or change.

There is, however, another type of rising power-factor curve which is more commonly understood and which is carefully avoided by the users of high-voltage cables. This is the rise in power factor due to the ionization of air layers or bubbles remaining in the paper structure during the process of impregnation. If such bubbles are large enough and plentiful enough a very definite rise in power factor with voltage results, hence the limit in the value of the ionization factor imposed by users of cables. An interesting analytical study of this type of power factor increase, with special reference to exceedingly minute bubbles, has been recently made by A. Gemant and published in the German literature. He assumes that these tiny bubbles go through a succession of breakdowns in each half cycle, the whole bubble coming to one value of potential after each breakdown and thereafter picking up stress again. Estimates are made of the mechanical impulse on the paper structure from the successive pounding of the ionic streams leading to breakdown and of the rate at which the paper structure is thereby broken down.

Complete failure results when the paper fiber is sufficiently destroyed to permit replacement by the oil and the ultimate breakdown strength is fixed by that of the oil. The suggestion is an exceedingly interesting one and the computations lead to figures which are reasonable as related to experiment and practice. Results of the further testing of his theory will be interesting.

Some industry securities are a savings fund bargain

DESPITE the extent of unemployment and incidence of salary and wage reductions prevailing at the moment, savings deposits are being built up by many people, indebtedness is being reduced and the foundations are being laid for future prosperity. One hears much superficial comment about investment securities at their present levels. Naturally the bonds and stocks of the electrical industry are not exempt in view of the recession in prices and the reduction in dividends experienced in the case of innumerable investors. It is well to remember, however, that if the securities of the industry finally failed to remain depression-proof, a great many of them continue stoutly depression-resistant, and constitute investment bargains of the first order when studied in the light of sustained earning power and clearly evident prospects.

The best bonds command respect as before; numerous preferred stocks are paying dividends with the regularity of the seasons, and the yields now available on a goodly number of seasoned commons deserve consideration from the thrifty. The opportunities at hand for the prudent saver and discriminating buyer of high-grade securities are unusual, and it is unnecessary to borrow money in order to participate in well-assured yields above the current rates of interest on collateral loans. Securities which have come through the baptism of fire in the past three years are plentiful enough and sufficiently well known to conservative advisers and students of market conditions to warrant purchase for a diversified savings portfolio.

Overcoming Instability

By H. L. CRUMLEY* and W. L. MANEY†

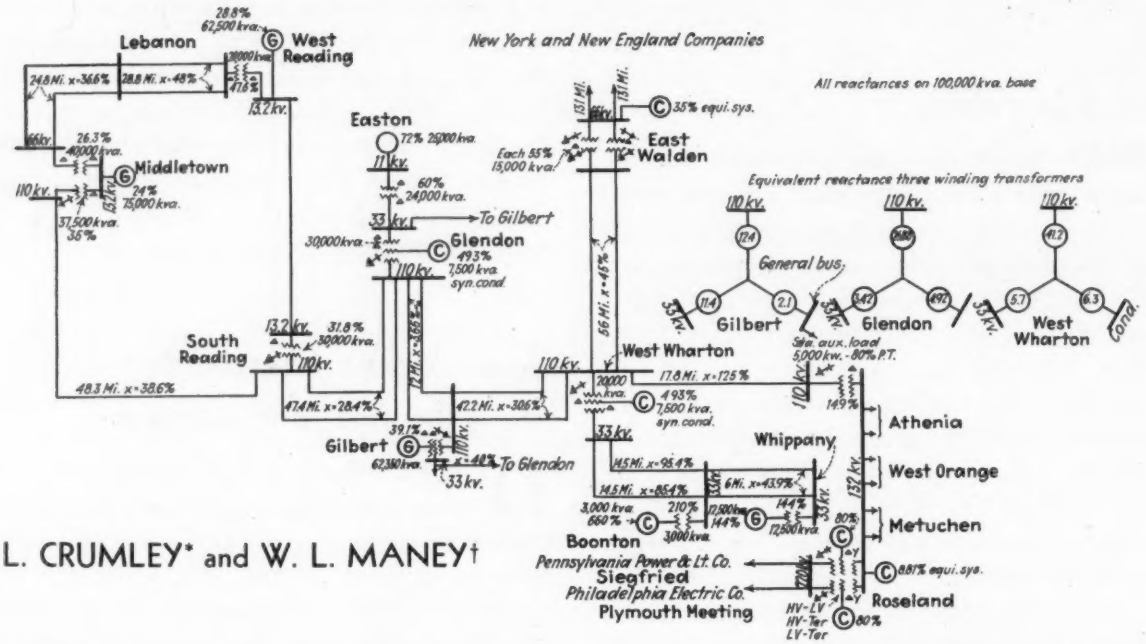


Fig. 1—The instability cured was manifested chiefly in vicinity of Gilbert station

This diagram includes the systems of the New Jersey Power & Light Company, Metropolitan Edison Company and interconnections with adjacent companies. The double circuit 110-kv. lines are on conventional steel towers (vertical configuration) with no overhead ground wire. The neutrals of all 110-kv. transformers are solidly grounded. The two generators of the 55,000-kw. generating set at Gilbert are permanently paralleled on a 13.8-kv. stub bus. One exciter directly coupled to the low-pressure element and separately excited from a direct-connected pilot exciter furnishes excitation for both generators.

INSTANCES of power system instability have arisen from time to time which, while disconcerting at first, have in general been successfully countered. During the lightning season of 1930, the first year in which the Gilbert station of the New Jersey Power & Light Company operated regularly under full load, three cases of instability occurred. Each of these was caused by a severe transmission line short circuit resulting from lightning flashover on the 110-kv. circuits (Fig. 1).

Case I arose from a fault involving five conductors and ground on the two Glendon-Reading lines very close to Glendon. At the time Gilbert was delivering about 18,000 kw. to the west, 20,000 kw. to the east and 7,000 kw. to the 33-kv. system. Both of the lines in trouble cleared, but Gilbert pulled out of step with the systems to the east and the two 110-kv. transmission circuits, forming the link with the east, tripped at West Wharton owing to overcurrent resulting from surging.

Case II was rather complex. Initially with Gilbert station loaded as in Case I, the Gilbert-Glendon circuits got in trouble and tripped out. Gilbert apparently pulled out of step with the eastern system, but presumably pulled back into step. However, before the machines completely settled down after this disturbance a severe short circuit occurred on a 33-kv. feeder adjacent to the station, and this time Gilbert pulled completely out of step with the eastern system, both lines again tripping at West Wharton on overcurrent.

Case III — With Gilbert delivering approximately 5,000 kw. to the east and 45,000 to the west, a flashover occurred on the Gilbert-West Wharton lines, resulting in a double-circuit fault which involved three phases and ground. Both circuits tripped, but Gilbert station pulled out of step with the system to the west.

At the times of these cases of trouble the relay protection (Fig. 2) for each pair of 110-kv. circuits was a combination of balanced directional overcurrent (for both phase and ground) which provided protection for single-circuit faults, with directional overcurrent phase and power directional ground relays for each line which acted as "back-up" protection in the event of a simultaneous fault on both circuits.

For the balanced directional protection the conventional scheme of "cross-connected" current transformers was used, with the overcurrent relays so connected as to measure the differential or unbalanced current. Four relays of this type were used, three to measure the unbalanced phase current and one to measure the unbalanced residual or ground current. Under single-circuit fault conditions the faulty circuit was selected by means of a polyphase directional relay whose coils were also connected in the differential circuit. The directional overcurrent phase protection for each line consisted of three overcurrent relays associated with one polyphase

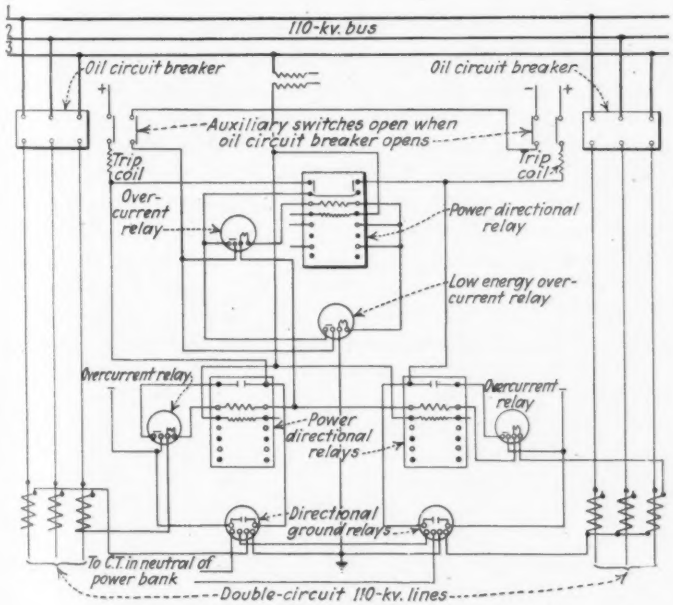
*Chief System Operator Metropolitan Edison Company.
†Central-station Engineering Department, General Electric Company.

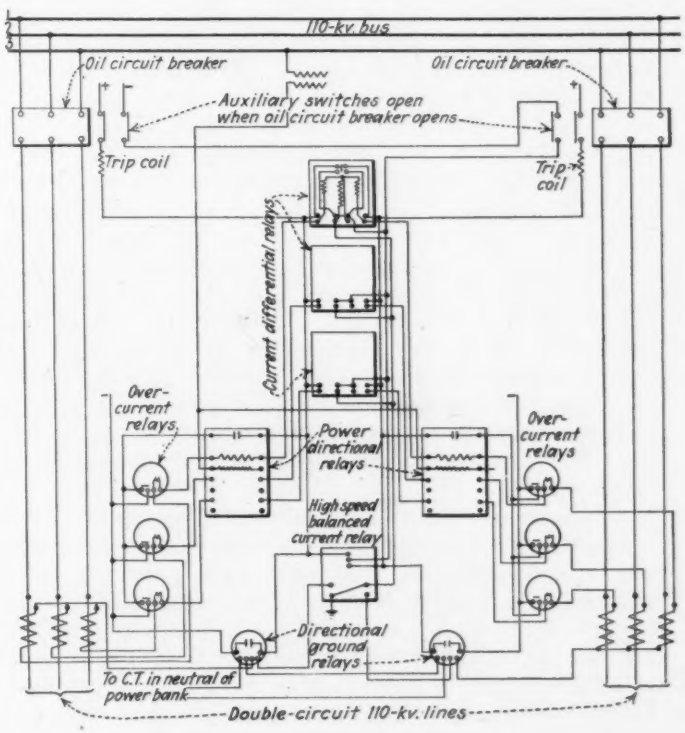
directional relay. The most modern type of power directional ground relay was employed for clearing double-circuit ground faults. This relay operates with two current coils acting upon a single disk, one coil being connected in the neutral wire of the current transformer secondaries and the other coil connected to the secondary of a current transformer in the grounded neutral of the power transformer.

With this relay protective system the minimum time of clearing a single-circuit fault on one of a pair of parallel lines was 0.65 second, while the minimum for clearing a double-circuit fault was 1.25 seconds, and this time might be as much as 1.70 seconds. All of these values represent total time from inception of the arc to its extinction.

Correctives considered

Immediately after the second of these occurrences an investigation was started by engineers of the Metropolitan Edison Company and the General Electric Company to ascertain the reasons for this difficulty and possible remedies. The studies clearly showed that during these severe disturbances there was a lack of sufficient synchronizing power between Gilbert station and the other generating stations. Because of the condition of reduced voltage and increased impedance during the existence of a fault on the system the power developed by the Gilbert unit could not be delivered. Thus with input in excess of output (since the steam supply could not be immediately cut off) Gilbert would run away from the remainder of the system, though the two machines in the Gilbert station would not pull out of step with each other.





Figs. 2 and 3—Original and revised relay protection

The original relay scheme (left) for the double-circuit 110-kv. lines provided balancer-power protection for single-line faults and reverse power protection on each line for back up in case of a double-circuit or bus fault. The new scheme (right) provides balanced-current protection for single line faults and reverse-power protection as before. For clarity, only one current transformer circuit is shown complete in the original scheme and the corresponding potential circuit merely indicated. In the new scheme, for the same reason, only one phase of the potential circuit is indicated.

This understanding of the problem led to consideration of a number of curative measures.

High-speed excitation was looked into but discarded as a possibility, since it offered practically no promise of improvement and would have required major changes in the excitation system, including new exciters.

The use of shunt or series resistors plus a switching scheme to connect them in circuit on the occasion of a fault was contemplated as a means of absorbing the excess energy of the Gilbert units during the period when that excess energy could not be delivered over the outgoing lines. Along this same line of attack consideration was given to the possibility of equipping the turbines with high-speed valves to cut off steam more rapidly. The objections to both of those methods were that they were new and untried in operation, would involve an appreciable expense and neither one of them struck directly at the trouble. While either method would have made it possible to maintain Gilbert in step with the remainder of the system, neither would contribute directly to the stability of motors adversely affected by the shock.

Remedy adopted

The remedy finally adopted promised much in giving relief to the trouble. It required the speeding up of system relaying and increased speed of arc interruption by oil circuit breakers. The advantage of this attack was that it would not only make it possible for Gilbert station to maintain stability during these severe disturbances but, in addition, would relieve the entire system and minimize annoyance to customers. Further than that, it appeared highly probable that with the resulting decreased period of faults flashovers originating as single conductor to ground and involving but a single circuit would in many cases be cleared before spreading to other phases or the other circuit.

Calculations made to determine the behavior of the system during various types of disturbances showed that the system could easily withstand a phase-to-ground fault

in any location with the existing protective equipment. Phase-to-phase faults on one circuit and not involving ground would not cause instability if switched in a reasonable time. However, it appeared that a switching time of 0.3 second or less would be required to maintain stability for two phase-to-ground and three-phase faults near Gilbert.

The attainment of such switching speed demanded not only improved relaying but also an improvement in oil circuit breaker speed, as the existing breakers had an opening time of 0.4 second, from energizing the trip coil to arc extinction. However, stability at Gilbert could be maintained if but six of the 110-kv. breakers (four at Gilbert and two at Glendon) on the lines to Reading were speeded up sufficiently. Accordingly these six breakers were equipped with Deion grid contacts. This modification gave an expected over-all operating time of 0.167 second.

There are several varieties of relays available for clearing single-circuit faults where circuits are operated in parallel. These are usually of the balanced-current type and will operate in two or three cycles or less. Therefore, there was no problem for the case of single-circuit faults in double-circuit lines.

However, operating records showed a considerable number of two-circuit faults which might have resulted from an arc in one circuit blowing over to the other or which might have originated as simultaneous lightning arc-over on both circuits. Thus no solution could be regarded as acceptable which did not provide for extremely rapid clearing of two-circuit faults as well as single-circuit faults.

Rapid clearing of two-circuit faults essential

Time overcurrent relays, frequently with power directional relays, are generally used in conjunction with balanced-current relays to give protection to parallel lines for faults involving both circuits. Such relays already were in use and could not be set to operate under 0.6 second, so they were out of the question. Directional distance relays are obtainable which would give two- or three-cycle operation over about 80 per cent of the length of the lines protected, but a minimum of 0.5 second beyond that. However, a relay setting of 0.5 second on the last 20 per cent of the Gilbert-Glendon lines was not satisfactory as this part of the line was in the danger zone. Moreover, directional distance relays necessitate high-voltage potential transformers.

The solution (Fig. 3) was to use standard mechanically balanced, current differential relays (type PD-3) for balanced-phase protection and beam-balanced current differential relays (type RDC) for balanced ground protection. These in themselves constitute no departure from standard practice nor do they give two-circuit protection. This was secured by rearranging the transmission conductors on what may be termed a probability basis.

Theoretical considerations and operating data indicated that the most prevalent double-circuit fault involved the two top conductors. The next most prevalent fault involved both top conductors and either or both of the middle conductors. Practically no fault involved all six conductors. Any of these faults might involve ground.

On the basis of this information the following arrangement was adopted:* The circuit on one side of the tower was left untouched with phase "A" on top, phase "B" in the middle and phase "C" in the bottom position. The circuit on the other side of the tower was changed so that "C" phase was on top, "B" phase remained in the middle and "A" phase was on the bottom. This resulted in an arrangement in which practically every double-circuit fault would result in an unbalanced condition in at least two relays and would permit them to clear both circuits. For instance, if the fault involved only the two top conductors the "A" phase balanced-current relay would trip the circuit having "A" phase on top, and the "C" phase balanced-current relay would trip the other circuit having "C" phase on top.

The solution has fulfilled its promise of improvement. The speedier clearing of disturbances is apparent. In some instances single-circuit faults clear quickly enough to prevent tripping the high-speed voltmeter in the system operator's office. Double-circuit faults clear very quickly, though not quite so quickly as single-circuit faults.

Only one case of instability has occurred since these changes were made. During a lightning storm a bushing flashover occurred on the transformer-bank side of a 110-kv. oil circuit breaker at Glendon substation. A simultaneous fault occurred on the Glendon-Reading lines. The time required to clear both faults was long enough to cause instability at Gilbert. No other cases of instability involving Gilbert station have occurred.

**Proposed by O. C. Traver of the General Electric Company.*

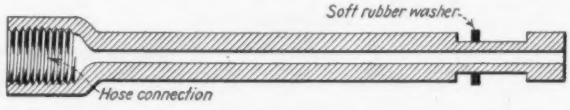
▼

Cleaning Condenser Tubes

By A. N. SIMMONS
Detroit Edison Company

Shooting rubber and canvas plugs with about 80 lb. water pressure behind them through the tubes is the method used in cleaning condensers. Usually the work is done by teams of two men, one handling the hose nozzle, the other inserting the plugs and then going round to the other end of the condenser and catching them in a small net as they pop out. In the Trenton Channel station of the Detroit Edison Company two teams worked together on each unit. But it seemed to Jack Eataugh, foreman of the housekeeping crew, that a lot of time was wasted in trotting back and forth between the condenser ends to get the plugs back to be used over again. He figured that rubber and canvas plugs are cheaper than human labor. So he had enough plugs made to fill all the tubes at once and he made a catch net large enough to fit over the aft end of the condenser. Now the nozzle men insert the plugs themselves and the whole condenser is cleaned in about half the former time.

Another improvement that saved time and work was to install permanent water connections near the head end of the condenser so there are only short hose lengths to



handle. Hose nozzles were re-designed as illustrated. The straight section, about 8 in. long, fits fairly snug in the tube and the rubber washer in the cylindrical groove is driven back against the shoulder and seals the tube, preventing the water from backing out.

How System Losses Were Reduced

By LEO SHAPIRO
Electric Distribution Engineer
Central Illinois Public Service Company, Springfield, Ill.

A PREVIOUS article* analyzed methods of accounting for losses, the ascertainment of preliminary load data, load surveys and the value of increasing wire sizes. This installment applies the results to tangible loss reduction.

It is desirable to reduce the ratio of distribution transformer capacity to maximum demand to a value less than two. Rural systems will probably exceed this ratio under present loading conditions, but the average urban distribution system should have a ratio between 1½ and one. This means that the majority of the transformers will be overloaded at the peak. In general, a transformer may be overloaded until regulation becomes a deciding factor. This is true for peak loads of short duration as normally occur on distribution transformers.

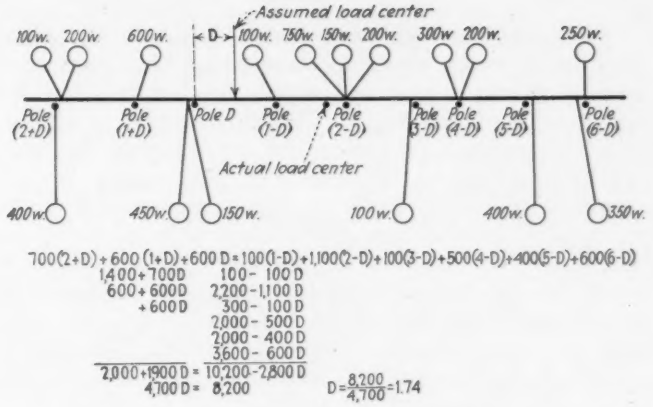
Before any changes are made in the capacity of transformers because of over- or under-loading of existing transformers loss calculations should be made of each transformer size under consideration for the load served. Since the losses of a transformer are divided in two parts, one a so-called fixed loss and the other a variable loss, changes in transformer capacity may sometimes be found to result in higher over-all losses than had prevailed with the original transformers. This is particularly true when it is considered that one loss is a function of the square of the voltage, while the other is a function of the square of the current. Methods for calculating these comparative losses are given in a later paragraph.

Transformer locations

The location of a transformer is usually decided upon by an inspection of the system served. Where the load is light little additional loss is encountered. Where the load is comparatively heavy the copper loss in the secondaries may be increased appreciably if the transformer is not placed at the load center. The "law of moments" method can be applied very easily for determining the pole location for the distribution transformer. This method, shown in the accompanying chart, should be used where heavy loadings are involved, to reduce the line losses to a minimum.

The next item for consideration in improving the efficiency of a distribution system is the balancing of transformers on the three phases of the primary system. It is not sufficient that the three phases be balanced at the substation or feeder terminals, but each section along the primary feeders should be balanced within itself. This is not always physically possible, but some changes can be made in nearly every system that will more nearly approach this goal when a conscientious effort is made in this direction.

*See Electrical World for July 16, page 76.



$$700(2+D)+600(1+D)+600D=100(1-D)+1{,}100(2-D)+100(3-D)+500(4-D)+400(5-D)+600(6-D)$$

$$1{,}400+700D \quad 100-100D$$
$$600+600D \quad 2{,}200-1{,}100D$$
$$+600D \quad 300-100D$$
$$2{,}000-500D$$
$$2{,}000-400D$$
$$3{,}600-600D$$

$$2{,}000+1{,}900D=10{,}200-2{,}800D$$
$$4{,}700D=8{,}200$$
$$D=\frac{8{,}200}{4{,}700}=1.74$$

"Law of moments" method

The secondary system may be considered as a lever, the transformer as a fulcrum and the demands of the various services as weights. For simplicity in calculation, the length of a span is called unity distance. The problem is to find a point on this "lever" such that the moments on each side of the fulcrum will be equal. This will be the proper location for the transformer. To find this point, each load is multiplied by its respective distance from an assumed load center, *D*. The sum of these products on one side of the assumed fulcrum is balanced against the sum of the products on the other side of the fulcrum and the true distance *D* found in terms of unit spans. The closest pole should be used for the transformer location. Should the point *D* be found a negative quantity, it is an indication that the load center was assumed in the wrong direction and it is only necessary to apply the answer in the opposite direction to locate the load center.

Balancing of the primary should preferably be done by means of ammeters located in the feeders at the substation or at the center of distribution. Balanced primary feeders not only help reduce line losses to some extent but also improve the voltage conditions of the system.

In many instances the capacity of substation transformers is chosen on the basis of future anticipated loads rather than existing demands. Such choice is often arrived at as a result of a thorough economic study. In other cases existing substation installations occasionally suffer a severe reduction in load due to slackening of operations of large power users. Then, too, we have the substation serving a large power load that is seasonal or periodic in its demand as, for example, canning factories or drainage districts.

All of the above conditions of service lend fruitful fields for studies in loss reduction. Will it be possible to operate the substations in open delta to reduce the transformer losses during the light loading periods? Will a saving be effected by the installation of an auxiliary bank of considerably smaller transformers for light load operations? Each case must be studied and analyzed individually to arrive at the proper solution. The ratio of the average demand during the heavy load period to the average demand during the light load period, the losses of the transformers involved, the load factor of the respective demands and their periodicity are all pertinent factors. The dollars and cents value of the kilowatt-

hours saved should also be balanced against the cost of making the change. There is no advantage in expending more in making these changes than the resultant savings are worth, but it should be remembered that where the changes are made once the savings are repeated for years afterward.

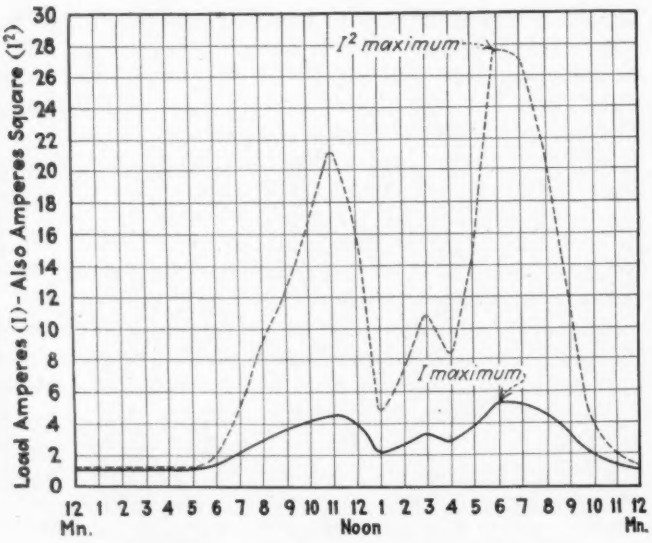
Metering

Some form of maximum demand indicator should be installed at every important substation. The substation demand should be read and recorded each month with the totalizing meter readings. This information is of considerable value, as explained before. Errors in meter registrations often produce unreasonable values in unaccounted-for losses. Faulty metering, particularly where instrument transformers are involved at large power installations, has resulted in serious losses in revenue. Metering installations should be inspected for mechanical defects and calibrated at sufficiently frequent intervals to insure accuracy of measurements. This applies equally to meters within the company's system as well as to meters for customer's service.

Current and potential transformers employed in metering should be tested for accuracy before installation and checked against faults each time the meter is tested. The ratio of current transformers must be suitable for the load carried. It is generally advisable to change current transformers when the demand drops off to 25 per cent of the rating of the existing current transformers. At this point the meter registration may be in error, and it is obvious that if some error occurs at the maximum load the meter will be greatly in error at most of the lighter loads.

Voltage levels

The question of transmission and distribution system voltages is one that cannot be discussed here. The factors governing the choice of voltages for the various systems are too complex to be treated in an article on unaccounted-for losses. Generally, other considerations decide in favor of certain voltage standards and system losses are regarded as a secondary consideration. When



Equivalent hours of maximum load

The area under the I^2 curve is divided by I^2 maximum to determine the equivalent number of hours' use of the maximum demand for calculating transformer copper loss.

"Ground detector" finds accidental grounds

loss comparisons are made between two or more operating companies, allowances should be made for conditions of service or supply that are not equivalent in the companies being compared. Loss data is most beneficial in following the trend of operating efficiencies within the individual companies from year to year.

The voltage level of transmission or distribution lines has a decided effect on the system losses. Transformers are designed to have rated core loss at normal voltage. Variations in line voltage will change the core loss in proportion to the square of the line voltage. Thus, a transformer having normal core loss at normal line voltage will have 121 per cent of normal core loss when the line voltage level is raised 10 per cent, and the total transformer losses will be raised to a value far greater than 21 per cent.

It is very important that the transformers used be designed for the operating line voltage level. Whenever it becomes necessary to raise the voltage level on the output side of a transformer, and this raise is produced by taps on the input or exciting winding of the transformer, the core loss will increase as the square of the voltage ratios. In this case the exciting winding is operated at normal line voltage, but with a reduced number of turns. The winding in operation is thus overexcited to an amount equal to the percentage of the tap employed. The effect on the magnetic conditions in the transformer is the same as when the full winding is connected to a line whose voltage is a like per cent above normal.

In a previous paragraph it was stated that a method would be outlined for calculating the kilowatt-hour losses of a transformer. The kilowatt-hour core loss is readily calculated by multiplying the rated core loss by the number of hours in the period under consideration. Correction should be made for the variations in line voltage level as above mentioned.

The calculation of transformer copper loss is a more

difficult problem. The load factor, or equivalent number of hours' use of the maximum demand, must first be known. To determine this value for average conditions throughout the property the Central Illinois Public Service Company made measurements at representative substations. One graphic ammeter was placed in a phase wire at typical substations supplying various classes of loads. Records over a period of several weeks were obtained at each of these substations. These records were first obtained during the summer months and the same tests repeated during the winter season.

No attention was paid to the ratio of the current transformers employed in making these tests, or, in other words, to the actual value of the current readings, as the shape of the load curve was the only information desired. All of these curves were combined and averaged, giving rise to a representative system load curve. From it we developed the I^2 curve as shown. The area under this I^2 curve, when divided by the peak value of the curve, gave us a figure that we were able to use in all transformer copper loss calculations. This figure was eight hours. Hence, to find the average daily copper loss of a main substation transformer, it is only necessary to multiply the copper loss at the maximum demand by eight.

As a corollary to this conclusion we can deduce that transformers serving an average type system in the property should have a ratio of core to copper loss equal to one-third, so as to obtain the highest all-day efficiency. When this ratio is fulfilled the fixed losses will be equal to the variable losses over the 24-hour period. In calculations involving average load systems we use eight hours when main substations are involved, six hours for secondary substations or small systems and four hours for individual distribution transformers.

Accidental and avoidable losses

The discussion so far has centered about the losses inherent in the physical make-up of transmission and distribution systems and methods for reducing them. Besides these inherent losses there are some losses that may be termed as accidental or avoidable losses. Included in this class are tree grounds, accidental grounds, accidental shorts and current theft.

Current theft can be detected by meter readers, meter inspectors or by check meters installed at the service pole or at the transformer pole. A watt-hour meter installed in the secondary lines at the transformer will measure all the energy supplied to the secondary system. By subtracting all of the customer's meter readings from the meter reading at the transformer the difference should give the copper loss in the secondaries and service drops only. This loss should be very small. An excessive loss should be immediately investigated. Local superintendents can assist materially in this direction by checking the customer's billings at frequent intervals.

Frequent inspections of the system and improved construction methods will eliminate the chances for accidental grounds or shorts. Construction standards are constantly undergoing changes tending to minimize the possibilities for such troubles. A device that has been developed for detecting stray currents is called a "ground detector." It consists of a "U"-shaped core and coil connected to a sensitive receiver. It is small and very convenient to use as it is only necessary to place the core over the wire and a current flow as low as $\frac{1}{10}$ amp. can be detected. Lightning arrester grounds and secondary neutral grounds of an entire distribution system can be checked with this instrument, in a very short time, for any accidental current flow. Such curent not only causes increased system losses but is also likely to be an annoying source of radio interference.

During an inspection of a distribution system several years ago the ground detector indicated a large flow of current at one of the transformer neutral grounds. Upon investigation it was found that one vertical ground wire was connected to the transformer neutral one span east of the transformer pole and the second vertical ground wire was connected to the 115-volt wire one span west of the transformer pole. It is probable that this latter connection was accidentally made when the system was constructed and was not noticed until an inspection was made with the aid of the ground detector. Later measurements revealed that this error caused a loss of energy of about 1,200 watts, or equal to an annual loss of $106.

It is hardly necessary to discuss the subject of tree trimming, as the consideration of energy loss due to tree grounds is probably of lesser importance than some of the other difficulties encountered when there are bad tree conditions. Since radio reception has grown in popularity it is no longer as difficult to obtain permission for tree trimming as it has been in the past. Bad tree conditions are a prolific source of radio interference and the public, in general, is aware of this fact.

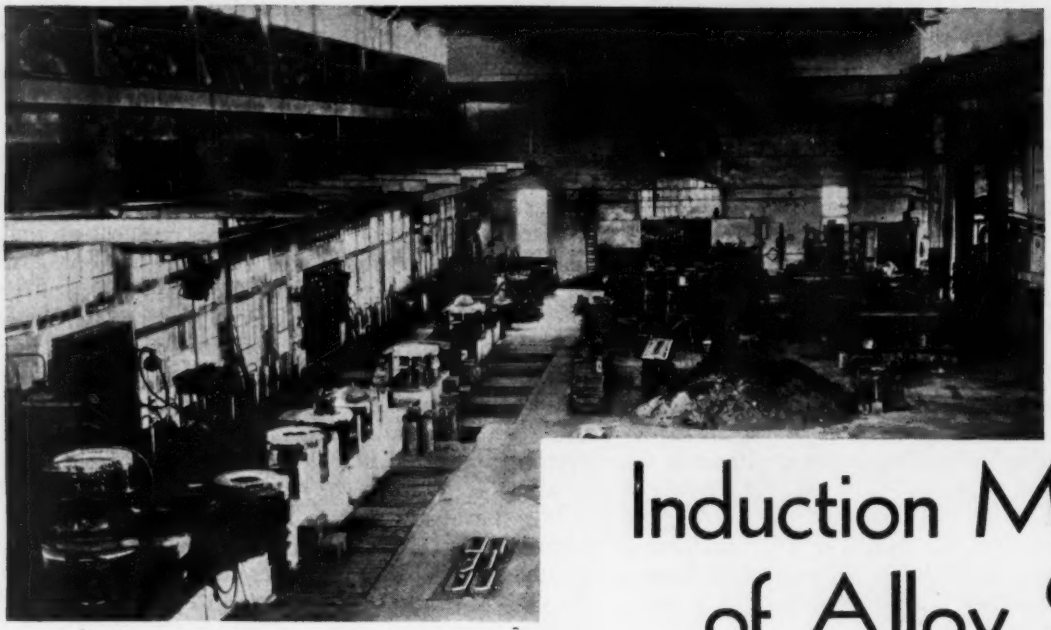
As is apparent from this article the greater part of any effort to reduce system losses consists merely of the conscientious application of the principles of distribution engineering. However, large systems have grown up by the integration of smaller units, many of which have emphatically not been engineered in distribution, but have simply grown by accretion. It is in locating and correcting the worst spots in these situations that efforts toward system loss reduction find greatest rewards.

▼

Sales of Electrical Equipment and Appliances to Farmers

If "dealer service" is a bottleneck restricting rural line merchandise sales, have the public utility companies made a proper presentation of this situation to the already-established retail channels or have they attempted to get this business direct? If the latter is true, to a considerable degree they discouraged the dealer at the very beginning, when he should have been given sales assistance. I wonder if utility companies have turned over to local dealers lists of patrons having power connections upon completion of lines so as to encourage dealer sales campaigns. Even though direct connections had not been made, dealers would have been glad to canvass prospects had they been in a position to meet utility competition.

C. H. CHASE,
Secretary Iowa Implement Dealers Association.



Induction Melting of Alloy Steels

New technique used with 60-cycle and high-frequency induction furnaces. Theory of furnace operation and characteristics of several types.

By M. H. MAC KUSICK
Babcock & Wilcox Company, Barberton, Ohio

ELECTRICAL engineers have recently put into the hands of metallurgists a new tool for melting metals that enables the melter to obtain careful regulation of the composition of his product and accurate control of the temperature of his melt. The Ajax-Northrup high-frequency induction furnace in its simplest form is made up of a crucible for holding the charge and a conducting copper coil wound around the crucible. The copper coil or tube is connected electrically to a source of high-frequency current supply so that electrical energy is transferred to heat energy in the metal in the crucible by direct induction by means of the high-frequency magnetic field established by the primary current in the coil. The copper tube is water cooled to prevent overheating from I^2R loss and from the heat leakage from the melt through the crucible wall. The coil and crucible are held rigid in a framework which is constructed so that extraneous heating by induction in the frame material is reduced to a minimum. Suitable switches and electrical connections are used to connect the furnace coil to the source of high-frequency power. Cooling water is carried to and from the furnace through flexible rubber hose lines, so that in tapping, the furnace may be rotated through 90 deg. about an axis which is in line with the pouring spout of the crucible.

Few design limitations

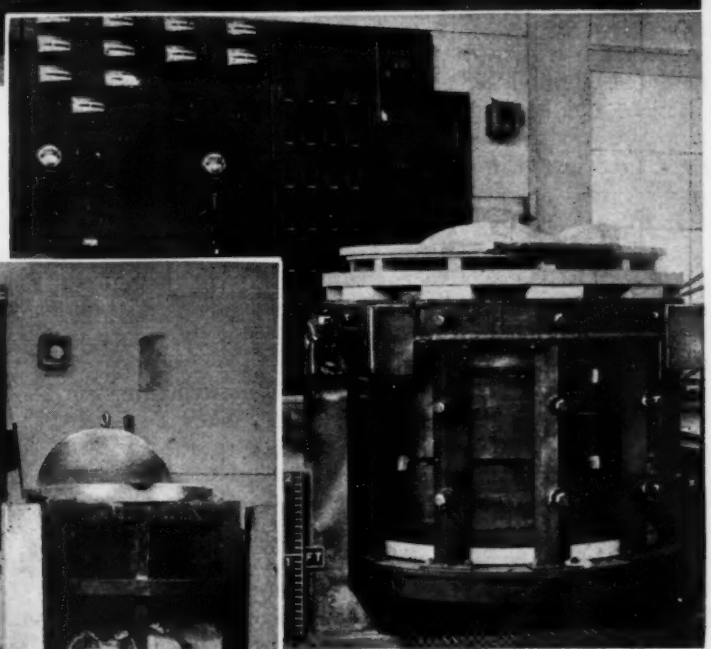
Furnaces of this type have been built in all sizes up to 8,000 lb. and designers foresee no inherent difficulties in the construction of much larger furnaces. The maximum size of high-frequency generators has not been reached; the largest built to date is of 1,250 kva. capacity, 960 cycles. Two such machines are in operation in this country at the present time. Manufacturers are ready to undertake the construction of a larger machine when industry demonstrates the need for its production.

The Babcock & Wilcox Company has pioneered the production use of high-frequency furnaces for melting stainless steels in this country and the first production unit installed for this purpose was a 150-kva., 2,040-cycle, 900-volt generator installed some six years ago in the alloy castings department. Two 1,000-lb. and two 400-lb. furnaces were installed for maintenance of production; lining or electrical repairs can be made on one furnace while the second is in operation. It may appear uneconomical to maintain two furnaces when only one can be in actual operation at a time, but when it is considered that the capital investment of a furnace is of the order of 5 to 10 per cent of the total high-frequency investment it is readily seen that enough furnaces for continuity of production should be installed. It is also advisable to have more than one size of furnace available when the heats to be melted are of widely varying size and composition.

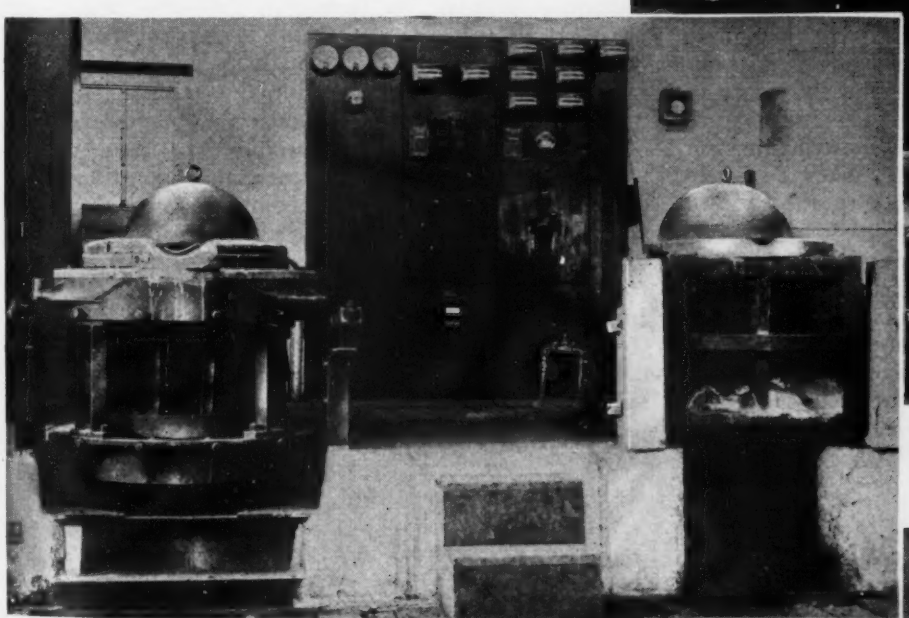
In August, 1931, a second and larger generator was installed. The second unit is a 1,250-kva., 960-cycle, 1,800-volt generator driven by an 1,800-hp., 2,200-volt synchronous motor; one other machine of this size is in operation in this country, these two being the largest machines built for this purpose to date. The change in frequency of the second unit to 960 cycles was made after considerable research regarding the most economical frequency to use for steel melting. Dr. Edwin F. Northrup, the inventor of the high-frequency furnace, and all others concerned with high-frequency melting have standardized on 960 cycles for steel-melting furnaces; in general, higher conductivity metals are melted

Pouring a 3,000-lb. steel alloy ingot.

Furnace operator with monorail tilting crane tapping a heat of stainless steel from a 3,000-lb. coreless induction furnace.



A 3,000-lb. shielded type induction furnace with a 1,250-kva. switchboard, including condenser contactor switches and voltage regulator panel.



A 60-cycle furnace at left and 1,000-lb. high-frequency furnace at right.

A centrifugal pipe-casting machine with heat-treating furnace at extreme left.

at lower frequency. The 1,250-kva. machine operates one 3,000-lb. furnace or two 1,500-lb. furnaces in parallel and the melting cycle is approximately one hour from tap to tap. Two types of 3,000-lb. furnaces are used, one is the standard design coreless induction furnace and the second is a "shielded" type.

Theory of induction furnace operation

In the induction furnace heat is developed in the charge by inducing electrical current in the charge material, which current is dissipated as heat according to the I^2R formula for dissipation of electrical energy in a conductor. The furnace is nothing more than a simple transformer, the primary circuit is the helical tube, water cooled, and the secondary circuit is the charge in the furnace. When current is flowing the primary circuit establishes a magnetic field within the crucible which alternates in direction and magnitude with the alternations of the primary current. The voltage induced in the secondary is proportional to the number of secondary turns—one in this case—the number of magnetic flux lines linking with the secondary and the frequency of alternation of the flux lines. For a given secondary voltage the higher the frequency the weaker the magnetic field that will be necessary to produce the secondary voltage, and hence the smaller the number of primary ampere turns to produce that magnetic field. The magnetic field in the induction furnace has to be established in a medium of low magnetic permeability and it is difficult to establish a very strong field in this medium as the primary ampere turns are limited by the amount of heat it is possible to carry away from the primary in the cooling water, hence the desired power is transferred to the secondary by increasing the frequency of a comparatively weak magnetic field. The furnace primary coil is a helix of cylindrical construction, for obvious reasons, and the magnetic field takes a straight path through the furnace coil parallel to the axis of the coil, but spreads at the top and bottom of the furnace. The return field at the top and bottom theoretically spreads over an infinite area as it returns on the outside of the furnace and the outside field is much weaker than the field inside the furnace, but metal parts in the furnace framework are cut by some of the return flux lines and therefore are subject to some degree of inductive heating. The framework must be constructed so that extraneous heating is reduced to a minimum; non-magnetic steel may be used or the furnace may be shielded to protect the framework against heating.

In a shielded furnace the return magnetic field on the outside of the primary coil is restricted so that the furnace framework is not subject to induced heating. The return magnetic field is forced through a path between the furnace primary coil and a second shield coil. The shield coil is a short-circuited series of windings; any magnetic lines that pass outside the shield bands induce a voltage in the shield winding, which in turn establishes a current in the shield and a counter magnetomotive force which opposes the outside flux and hence tends to force all but a small number of flux lines down through the space between the primary coil and the shield coil. The primary coil is supported by non-metallic elements in the form of vertical ribs which are wedged between the primary coil and the shield coil. The framework outside the shield coil may be made of any material desirable for structural strength. The magnetic field is restricted so that only an insignificant number of magnetic lines pass through the framework and no undesirable heating is experienced. It is important to note that the space through which the return field is forced, between the primary coil and the shield coil, must be of sufficient area that the flux density in this path will be low, otherwise the magnetomotive force of the shield band will be large and the shield current will cause excessive heating in the shield bands.

The primary coil is insulated from the charge material by a layer of insulating cement; mica and asbestos cloth may be used; the furnace is then lined with from 2 to 4 in. of refractory cement. The space occupied by lining material causes the furnace to have a low power factor due to the leakage flux linking with the primary winding, but not with the secondary. The power factor of a furnace depends upon furnace size, frequency of the current supply, lining thickness and upon the nature of the charge; i.e., size and shape of the scrap when solid and whether it is magnetic or not. The power factor in general increases with furnace size—7 to 8 per cent for a 400-lb. furnace, 10 to 15 per cent for a 3,000-lb. furnace. This is due to the increase in the ratio diameter of crucible to diameter of primary coil, and as the lining thickness does not increase greatly with furnace size the power factor increases with increase in furnace dimensions. To compensate for low power factor static condensers are used in parallel with the

Steel Alloys Melted in Induction Furnaces

B.&W. Alloy	Carbon		Manganese		Silicon		Chromium		Nickel		Molybdenum	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
500	....	0.25	0.30	0.60	1.0	2.0	28.0	30.0	....	0.75	...	...
600	....	0.16	0.50	0.75	....	0.75	17.5	20.0	7.5	10.5	...	...
601	....	1.0	0.50	1.0	....	2.0	17.0	19.0	7.0	9.0	...	...
602	....	0.07	0.50	0.75	....	0.75	17.5	20.0	7.5	10.5	...	...
610	....	0.15	....	0.75	2.0	2.5	17.0	19.0	7.0	9.0	...	...
620	....	0.25	0.50	0.75	....	0.75	17.5	20.0	7.5	10.5	...	...
640	....	0.20	....	0.60	....	0.75	16.5	18.5	8.5	10.0	3.0	3.5
642	....	0.07	0.50	0.75	....	0.75	17.5	20.0	7.5	10.5	3.0	3.5
650	....	0.16	0.50	0.75	....	0.75	22.0	25.0	10.0	13.0	...	...
651	....	0.50	0.50	0.75	....	2.5	22.0	25.0	10.0	13.0	...	...
700	0.40	0.60	....	0.60	2.0	2.5	16.0	20.0	62.0	68.0	...	...
800	1.0	1.5	0.75	1.25	1.0	2.0	24.0	26.0	10.0	12.0	...	...
900	....	0.25	0.40	0.75	0.75	1.25	17.0	19.0	....	0.5	...	...
901	1.0	1.25	0.40	0.75	0.75	1.25	17.0	19.0	....	0.5	...	...
1,100	0.30	0.40	....	0.75	1.5	2.5	22.0	26.0	19.0	24.0	...	...
1,103	....	0.15	0.50	0.70	0.70	1.5	24.0	26.0	19.0	21.0	...	...
1,500	0.25	0.35	0.50	1.0	1.5	2.5	26.0	28.5	7.5	9.5	...	...

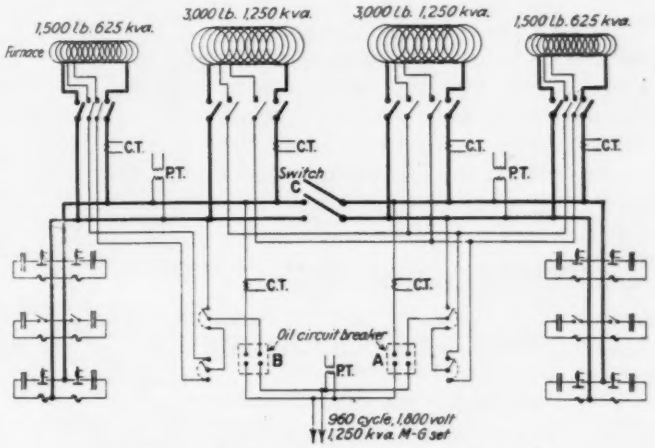
furnace primary. Enough condensers are used to maintain the combined system of furnace and condensers at unity power factor so that the generator supplies only the energy current to the system. Power factor changes during the melting down period, so that the condenser circuit has to be variable and condensers are thrown across the line when needed by means of magnetic contactors.

Use of 60-cycle furnace

In the foregoing it was pointed out that a weak magnetic field combined with a high frequency gives the same power input to a charge as a strong magnetic field at low frequency. The Babcock & Wilcox Company has designed a 60-cycle furnace of the coreless induction type which is operating satisfactorily. It is a nominal 1,000-lb. unit with a holding capacity of 1,400 lb. Due to the characteristics of the furnace a melt has to be started with a continuous secondary circuit; at this low frequency small pieces of scrap will not have sufficient energy induced in them to cause a melting temperature to be reached. The furnace may be started by using a solid slug of metal that fits snugly into the crucible and continuity of production is obtained by leaving approximately 400 lb. of molten metal in the furnace after tapping to start the next heat. The efficiency of a 60-cycle furnace is less than that of a similar size and power input furnace of the high-frequency type. However, power for the furnace is taken from the 60-cycle lines by means of a 2,300- to 230-volt power transformer, and as the efficiency of such a transformer is much higher than the efficiency of a high-frequency motor-generator set the over-all efficiency of the 60-cycle melting unit is slightly better than for the same size and power input high-frequency unit. Moreover, the capital investment of a 60-cycle melting unit is less than the investment for a similar size high-frequency unit. The fact that the furnace is limited in use due to the necessity of maintaining a continuous secondary circuit for starting the heat makes it less desirable for some purposes than the high-frequency type furnace, which will melt "cabbaged" or punchings or other finely divided scrap without difficulty. An objectionable feature of this furnace is the rapid agitation of the bath when molten.

All furnaces of the coreless induction type are subject to some stirring of the bath, and this is a desirable feature up to a certain point. Excessive agitation may be undesirable if oxidation of the metal becomes excessive, causing the steel to be "dirty." Motion of the molten bath is caused by the electrodynamic forces set up by the secondary currents of the furnace and by the reaction between the primary and secondary currents, similar to the forces in a static transformer that may disturb the windings when a heavy short circuit occurs, and also by the electromagnetic forces set up by the fringing flux at the top and bottom of the furnace which reacts with the current in the bath. As the strength of the magnetic field is much greater in the 60-cycle furnace than in a similar high-frequency furnace and, moreover, the currents in the bath are larger, the motion of the bath is much greater. The 60-cycle furnace is operated without static condenser power-factor correction and the plant power factor is maintained at unity by overexciting synchronous motor drives in the high-frequency generator room and in the plant power house. It must be noted that such an installation would not be practical in a small plant or in one where synchronous machinery was not of sufficient extent to compensate for the low power factor of a single-phase load of this type. Power input to the furnace is regulated by taps on the furnace coil and by a voltage type changing switch on the secondary winding of the 2,300- to 230-volt power transformer.

The coreless induction furnace is very well suited to remelting low carbon stainless scrap as there is no carbon pick-up during the melt. It is very difficult to remelt stainless steel scrap in the arc furnace without introducing some carbon into the melt from the electrodes. It is impractical to "ore down" the carbon in a melt because the "oring down" process reduces the alloy



Furnace wiring diagram for a 960-cycle motor-generator set

3,000-lb. furnace—Use oil circuit breaker *A* with switch *C* closed.
1,500-lb. furnace—Operate independently on oil circuit breakers *A* and *B* with switch *C* open.

content of the bath more readily than it reduces the carbon. The induction furnace remelts low-carbon stainless steel scrap without changing the carbon content, and in melting down a charge of 18 per cent chromium, 8 per cent nickel-steel scrap, only 0.40 per cent chromium is lost and no nickel loss occurs. The accompanying table of alloys gives an analysis of the most commonly melted steels made in the furnaces at this plant. Steel of any analysis is made without difficulty.

Sensitive to temperature control

The induction furnace is very sensitive to temperature control and power input is controlled very accurately by adjustment of the generator voltage, which may be done automatically or by hand. Temperature of a heat is checked by an optical pyrometer and by burning off a standard rod in a given time.

On a 24-hour basis the melting units will produce 40 tons of steel per day. The large tonnage requires special handling of the scrap from the storage bins to the furnace platform. A 2-ton monorail crane system is used for this purpose. The monorail is located directly above the center line of the furnaces and runs out to the weighing platform. A second monorail system is used to tilt the furnaces in tapping; two hoists are used on this track as two furnaces may be tapping at the same time. The molding floor is serviced by one 10-ton traveling bridge crane and one 3-ton traveling bridge crane; the smaller crane can be run outside the building

to the flask storage yard and the shipping tracks. The shop is equipped with automatically regulated gas-fired core ovens. A large centrifugal machine is used to cast pipe up to 10 in. outside diameter of any wall thickness. This machine is similar to the one used at the Watertown Arsenal for casting gun barrels centrifugally.

The outlook for high-frequency melting is bright. Producers of high-grade special steels recognize the many advantages of this type of furnace. One plant is melting steel for the production of special shears and cutting tools including razor blades, in the induction furnace. There are several installations for making high-speed steel ingots. The Army arsenal at Watertown uses induction melted steel in the production of centrifugally cast guns. Many well-equipped metallurgical laboratories use small induction furnaces for development and research work. The steel industry seems well pleased with this latest contribution of the electrical engineer to the advancement of its melting technique.

▼

Customer Statistics Classified by Counties

Eighty per cent of the domestic electric light and power customers live in places of 2,500 population, or larger, although these towns contain only 56 per cent of the total population.

A summary of urban and rural customers by states, compiled with the close co-operation of the National Electric Light Association, has been published by the Electrical Equipment Division of the Bureau of Foreign and Domestic Commerce, and is here reprinted. Similar tables, giving the allocation by counties, are available from the bureau for each individual state.

These state tables also give the number of customers in each city and so, combined with the county statistics, provide a basis for market analysis covering the entire United States never heretofore approached for detailed information in this field.

2,300,000 Village Families Still to Be Served

While nineteen out of every twenty families living in the cities of the United States now have electric service, there remains abundant room for electrical growth on farms and in the smaller villages.

By combining the statistics of the national census of 1930, the classification of electric light and power customers recently published by the Electrical Equipment Division of the Bureau of Foreign and Domestic Commerce and the National Electric Light Association statistics on farm customers as of the end of 1930 it is possible to estimate quite closely the degree of saturation for each of three groups—the urban, or those in places of 2,500 population or larger; those on farms, and the intermediate group living outside of the cities but not on farms; that is, the non-farm rural customers. For practical purposes these last may be assumed to live, in the main, in smaller villages and hamlets. For brevity they are listed as "village" in the following table:

	Population	Families	Customers	Saturation, Per Cent
Total	122,775,046	29,980,146	20,049,450	67.0
Urban	68,954,823	16,830,000	15,962,168	94.9
Rural	53,820,223	13,150,000	4,087,282	31.1
Farm	30,447,550	7,430,000	650,000	8.7
Village	23,372,673	5,720,000	3,437,282	60.0

The statistics all refer to some time in 1930 and so are comparable, for practical purposes. The classification by families is estimated. Only the total has been announced. The error in assuming that the number of families in the several groups is proportional to population is probably not serious.

On the basis outlined it appears that 95 per cent of the families in urban communities have electric central-station service, while only 31 per cent of the remaining population has such service. Breaking up the latter group, service extends to 60 per cent of the village population, while only 9 per cent of the farm population is reached. In round numbers 2,300,000 families living in small communities are still potential customers.

Urban and Rural Domestic Customers—August 31, 1930

State	Urban	Rural	Total
Alabama	112,140	37,714	149,854
Arizona	37,950	16,319	54,269
Arkansas	67,105	29,850	96,955
California	1,218,589	295,199	1,513,788
Connecticut	275,572	100,807	376,379
Colorado	127,764	42,145	169,909
Delaware	24,632	13,535	38,167
District of Columbia	104,154	.....	104,154
Florida	150,606	32,498	183,104
Georgia	122,705	40,662	163,367
Idaho	39,448	27,033	66,481
Illinois	1,392,061	208,718	1,600,779
Indiana	440,206	149,495	589,701
Iowa	241,415	156,776	398,191
Kansas	182,309	103,840	286,149
Kentucky	183,454	58,087	241,541
Louisiana	137,133	29,669	166,802
Maine	79,076	74,929	154,005
Maryland	201,017	74,919	275,936
Massachusetts	880,208	84,937	965,145
Michigan	750,370	182,612	932,982
Minnesota	291,245	82,425	373,670
Mississippi	47,379	25,593	72,972
Missouri	436,107	115,796	551,903
Montana	44,747	21,851	66,598
Nebraska	119,434	78,615	198,049
Nevada	8,223	5,041	13,264
New Hampshire	58,656	39,159	97,815
New Jersey	767,094	149,095	916,189
New Mexico	21,057	8,380	29,437
New York	2,648,140	351,644	2,999,784
North Carolina	138,347	75,373	213,720
North Dakota	22,954	25,241	48,195
Ohio	1,086,274	224,460	1,310,734
Oklahoma	164,803	57,934	222,737
Oregon	132,629	62,364	194,993
Pennsylvania	1,403,944	328,899	1,732,843
Rhode Island	146,510	16,279	162,789
South Carolina	55,767	28,997	84,764
South Dakota	30,013	33,099	63,112
Tennessee	166,231	38,452	204,683
Texas	435,565	110,335	545,900
Utah	62,963	31,499	94,462
Vermont	28,117	37,347	65,464
Virginia	158,523	60,199	218,722
Washington	235,891	105,092	340,983
West Virginia	98,710	50,934	149,644
Wisconsin	370,348	151,883	522,231
Wyoming	14,583	11,552	26,135
Grand Total	15,962,168	4,087,282	20,049,450

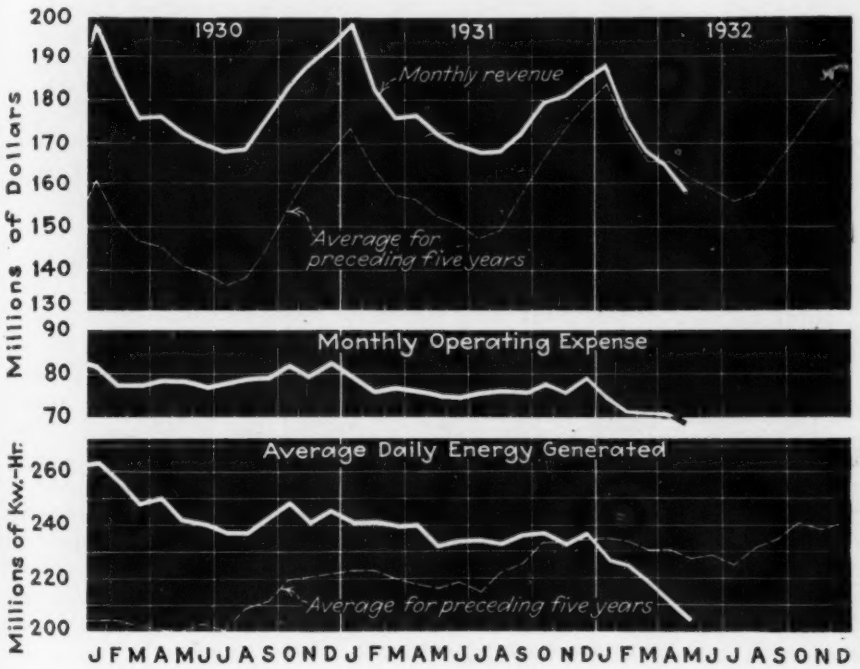
May Operations Generally Under Last Year's

MAY revenue of central stations normally shows a decrease from April, due to seasonal conditions. The average for the five-year period ended 1931 was 2.5 per cent. This year the decrease was somewhat larger, the estimated total for May based on returns received by the ELECTRICAL WORLD, $158,300,000, being down 4 per cent from the April figure, $164,860,000.

Earnings continue to fall short of those in 1931. The difference in May was 7.7 per cent, following 6.4 per cent in April, 4.3 per cent in March and 3.9 per cent in February for this year as compared with last.

For the first time, also, earnings are appreciably under the average for the month of the five-year period ended 1931, but the difference is still small, being about 2 per cent.

All of these figures include a certain amount of inter-company sales and are comparable with the total revenue for electric service reported for the latest available census of the industry, that for 1927. This reported a total of $1,802,655,493, or a monthly average slightly over $150,000,000.


1930
1931
1932
Monthly revenue
Average for preceding five years
Millions of Dollars
Monthly Operating Expense
Average Daily Energy Generated
Millions of Kw.-Hr.
Average for preceding five years
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Operating expenses, exclusive of interest, taxes and depreciation or sinking-fund deductions, fell to $68,070,000 in May from $70,756,000 in April and are down 8.7 per cent from last year. This leaves a net income of $90,230,000, against $96,990,000 in May, 1931.

Energy output decreased more than did the financial items; 6,209,000,000 kw.-hr., against 7,192,000,000 kw.-hr. a year ago, down 13.5 per cent. A portion of this decrease was in water-power output, which with 2,838,000,000 kw.-hr. was down 4.3 per cent, but by far the greater portion was in energy from fuels. This amounted to 3,371,000,000 kw.-hr., 20.5 per cent less than in 1931.

With the restoration of a larger stream flow, after the prolonged drought in the past two years, and with the reduced demand for energy it has been possible greatly to reduce the output of steam stations, which has for five consecutive months been at least 20 per cent under 1931.

Considered by regions the reduction in operations compared with last year has been general. It was largest in the Mountain states, 12.5 per cent in revenue and 25 per cent in energy output. Smallest decrease in revenue was along the eastern seaboard.

Table I—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1932	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
February	6,533,343	— 3.3	2,795,460	+36.1	3,737,883	—20.7	1,874,000	+ 3.0
March	6,833,168	— 8.0	2,919,523	+17.2	3,913,645	—20.7	1,884,000	+ 6.9
April	6,285,069	—12.5	2,939,350	— 0.2	3,345,719	—21.0	1,650,000	— 9.0
May	6,209,116	—13.5	2,837,785	— 4.3	3,371,331	—20.5	1,668,000	—10.5

Table II—Regional Operation, Revenue, Energy Output, in May, 1932

Compared with Corresponding Month of Previous Year

Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	158,300	— 7.7	6,209,116	—13.5	2,837,785	— 4.3	3,371,331	—20.5
New England	15,890	— 6.2	391,631	—18.5	245,425	—20.3	146,206	—15.0
Middle Atlantic	41,610	— 6.8	1,502,573	— 9.8	491,901	— 8.2	1,010,672	—10.7
East North Central	37,100	— 9.7	1,443,920	—15.5	222,425	+40.0	1,221,495	—21.2
West North Central	13,310	— 8.0	421,101	— 9.1	141,594	+25.5	279,507	—20.7
South Atlantic	17,910	— 4.5	768,290	—15.2	502,182	—13.0	266,108	—19.0
East South Central	5,310	— 7.7	276,050	—16.0	235,499	—15.5	40,551	—17.8
West South Central	8,020	— 8.7	314,162	—14.0	10,990	+58.0	303,172	—15.5
Mountain	3,630	—12.5	188,309	—25.0	149,921	—29.5	38,388	+ 0.3
Pacific	15,520	— 7.7	903,080	—10.0	837,848	+11.5	65,232	—74.3

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central-station operations.

Table III—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

Month	Total Gross Revenue from Sale of Energy*		Total Operating and Maintenance Expense†	
	1932 Thousands	Per Cent Inc.	1932 Thousands	Per Cent Inc.
Feb.	$175,110	—3.9	$71,190	—6.1
March	168,280	—4.3	70,690	—7.6
April	164,860	—6.4	70,756	—6.7
May	158,300	—7.7	68,070	—8.7

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.

†Does not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions.

Effect of Ionization on Impregnated Paper Insulation

By K. S. WYATT*

Research Department, Detroit Edison Company

LITTLE or no information has previously been available concerning the effect of ionization on the dielectric losses of oil-impregnated paper insulation. Many cable engineers have held that there would be no increase in dielectric loss if ionization took place in the absence of oxygen, and this viewpoint was supported by physical examinations of high-tension cables after a period of service. Large quantities of an insoluble wax, a deterioration product of the impregnating compound under ionic bombardment, were frequently found, but the wax was soon shown to possess excellent dielectric characteristics. There has also been a general belief that all hydrocarbons when pure possessed excellent electrical characteristics and that the structure of the hydrocarbon affected such characteristics but little. It is true that many unsaturated compounds have been frequently found to exhibit high dielectric loss, but it is extremely difficult to purify many unsaturated compounds completely, and the high loss characteristics have usually been attributed to the presence of impurities.

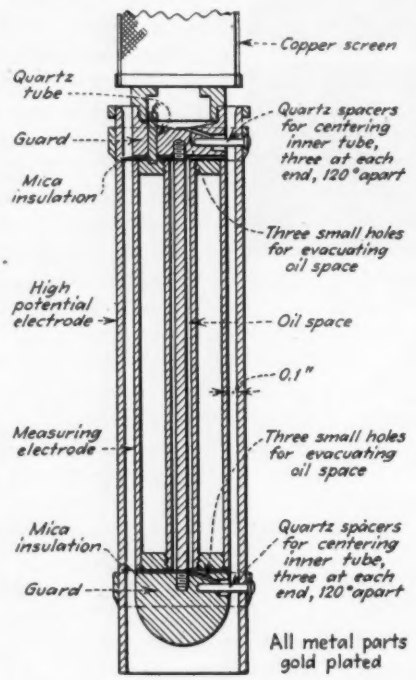

Copper screen
Quartz tube
Quartz spacers for centering inner tube, three at each end, 120° apart
Guard
Mica insulation
Three small holes for evacuating oil space
High potential electrode
Oil space
0.1"
Measuring electrode
Three small holes for evacuating oil space
Mica insulation
Quartz spacers for centering inner tube, three at each end, 120° apart
Guard
All metal parts gold plated

Fig. 1—Cross-section of cell for power-factor measurement

The average stress between electrodes is 47.5 volts per mil.

Experiments show that corona discharge may produce marked increases in the dielectric loss of certain insulating oils even when free from all impurities and when oxygen is rigidly excluded. This finding has been shown to hold for commercial compounds of non-resinous types also.

**From a paper before the insulation committee of the National Research Council.*

Tests were made in a cell whose original design is due to Hans Becker, modified to permit dielectric loss measurements on the oil. In operation the oil, carefully dried and degassed in a separate apparatus, is introduced into the evacuated cell until the level rises to within about 1¼ in. of an overpass tube. The space above the oil is maintained at a pressure not exceeding 1 mm. Power-factor and resistivity measurements are made at 10 deg. temperature intervals from 100 deg. C. to room temperature by immersing the cell in an oil bath controlled to 0.1 deg. C. An alternating potential of 15 kv. is then impressed across the electrodes on the outer and inner cylinders. Ionization, as evidenced by visible corona, begins at the surface of the liquid with the formation of small gas bubbles, in which ionization also occurs. The region of ionized gas bubbles gradually extends downward until the lower level reaches the bottom of the electrodes. The gas bubbles that are formed rise, carrying oil with them, until the entire space between the electrodes is filled with blowing bubbles surrounded by oil, which finally overflow through a tube into a power-factor measuring cell. Here the gas is drawn off, stored and analyzed and the oil trickles down into the power-factor cell. After 6.5 hours' bombardment the oil is shaken to insure thorough mixing and power factor and resistivity are measured at the usual temperature intervals from 100 deg. C. down. The oil is then given a second 6.5-hour period of bombardment and, after further shaking, the measurements are repeated.

Causes of power-factor rise are obscure

A Schering bridge was used for power-factor measurements. The third arm provides for zero potential difference between the active leads and their guards, thus eliminating any effects from shunting capacities. When used with the power-factor cell the power factor can be measured within about 0.0005. The measuring potential is 4,750 volts, giving an average stress of 47.5 volts per mil between the electrodes.

Results of several runs using liquid paraffin oil and a commercial cable oil (non-rosin) indicate that the increase in power factor with bombardment, although very small at room temperatures, is very marked at higher temperatures, usually of the order of several hundred per cent. The resistivity curves show a great change in slope with bombardment. The cause of the increase in power factor appeared to lie in some change in the oil itself, but this conclusion appeared contradictory to the generally accepted ideas. A search was therefore made for some cause of the increase other than changes in the hydrocarbon structure. The increase in loss could not be attributed to impurities in the oil, because in the

case of the liquid paraffin analysis showed no impurities to be present. Attention was turned to the pyrex walls of the discharge chamber, but no visible etching of the surface was evident and no impurities were detected by a spectroscopic analysis of a sample of the oil after bombardment. The results were similar with an all-quartz cell. Hence the possibility of the contamination of the oil by impurities from the glass was ruled out.

The liquid paraffin, which was colorless at first, became slightly tinged with yellow after bombardment. It was suggested that the increase in loss was perhaps due to colloidal carbon which was formed during the bombardment. If colloidal carbon were present it would have been in very small amount because of the scarcely detectable color change, and in any case it is difficult to explain the large increases in power factor on this basis. However, the oil before and after bombardment was examined under the ultra-microscope. No carbon could be detected by this means.

Another possible source of the increased loss was leakage of air. This would have been detected by the differential manometer used if it had occurred. Moreover, extreme care was taken to guard against leakage; ground glass joints were coated first with sealing wax and then with glyptol lacquer. However, analyses of the gas drawn off from the cell during each bombardment period showed either no oxygen or nitrogen to be present, or only traces; it must be expected that small amounts will always be present because of the difficulty of completely degassing the oil and of removing the adsorbed gas on the cell walls. The quantities of such gas, in any case, are far too small to account for the magnitude of the increases in dielectric loss.

Although each run on the same oil has shown considerable increases in power factor, the increases do not always check quantitatively. Evidently there are certain variables which have not been controlled. It was found that slightly different results were obtained with different cells, and this was thought to be possibly due to differences in the rate of circulation of the oil, which appeared in some cases to depend on the dimensions of the overpass tube. The energy input of each run was not measured exactly; since the voltage (15 kv.) is kept constant the energy input varies somewhat with the size of the bubbles in the discharge chamber and with variations in the thickness of the glass walls. It is believed that the energy input has not varied greatly in the several experiments.

An approximation of the relative energy input of the different runs for a given compound can perhaps be obtained by taking the volume of hydrogen evolved in each case. When change in power factor is plotted against gas evolved for liquid paraffin we obtain the curve of Fig. 6a and for the commercial cable oil that of Fig. 6b. It is clear that, considered on this basis, the power factor increases of the several runs check very closely. It may be pointed out, in passing that the power factor increase per unit of gas evolved is smaller with the commercial oil than with the liquid paraffin. The difference in slope of the two curves should also be noted.

In comparing different oils it will be noticed that the rate of circulation in the cell will vary with the viscosity and gas evolution properties. In order to obtain equivalent bombardment of each oil it would be necessary to equalize the rate of circulation; this might be done by

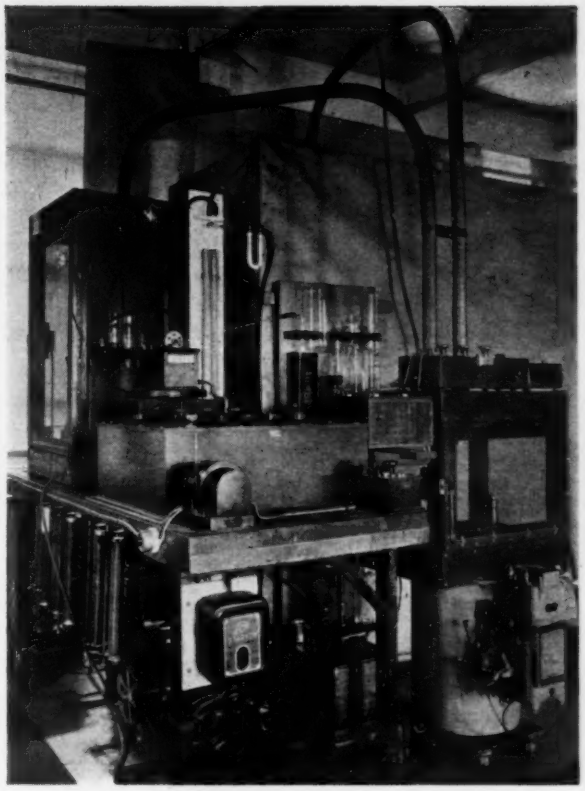


Fig. 2—Bombardment apparatus set-up and Schering bridge

controlling the diameter of the overpass tube. The rate of circulation of the liquid paraffin under approximate present conditions has been measured and is about 2 cycles per hour.

The temperature of the oil is a factor which might affect the results. All bombardment has been carried out at room temperature, which is constant within a few degrees Centigrade. The ionization produced does not appear to raise the outside temperature of the cell appreciably.

It was thought that the temperature within the gas bubbles during discharge might be so high instantaneously that pyrogenic cracking might occur, thus making the type of bombardment obtained in this cell unlike that obtained in cables in service. If this were true it would be expected that the gas analyses would show considerable quantities of acetylene present, which is always a product of pyrogenic cracking. Only traces of acetylene were found however. Hydrogen forms the larger part of the gas evolved. It is to be noted that the analyses check closely and that the composition of the gas from the two oils is very similar.

It might be expected that the effect of discharge on the oil would be to form unsaturates and polymerization products. Sulphuric acid values and iodine numbers before and after bombardment have been obtained; the data show a small increase in unsaturates. If polymerization had taken place to any extent the average molecular weight of the oil might be expected to have increased. Unfortunately no molecular weight determinations have been made. Viscosity has been measured, however, and the data show a slight increase after bombardment.

With the thought that if polymerization had occurred some volatile products might also have been formed, a

sample of one of the oils that had been subjected to discharge was heated to 140 deg. C. for four hours under 1 mm. or less pressure. The power factor dropped from 6 to 5.6 per cent. After standing two weeks the power factor again dropped to 4.8 per cent, no further drop occurring in an additional rest period of two weeks. On shaking the oil in the cell the power factor rose 5.8 per cent, or nearly to its original value, immediately after the bombardment. It is thought that the increase in power factor may be due to the increase in large molecular aggregates in oil. Bormann and Gemont have recently stated their belief that the losses in insulating oils are due in parts to non-homogeneities.

Ionization a weakening factor

When the results reported are thought of in terms of actual cable practice, it is clear that if ionization occurs in an operating cable the impregnating compound itself may deteriorate and increase considerably in dielectric loss. The deterioration products may not be uniformly distributed throughout the cable, but may be concentrated in spots which conceivably might factor in breakdown.

The modified Becker cell appears to be an effective tool with which to investigate the influence of corona discharge on the dielectric loss characteristics of insulating oils and papers. Work planned at the time of presentation of this paper included the studies of the effect of structure on the changes of dielectric loss of oils under electric discharge, using a number of papers of various types and of different degrees of purity, both in fiber and in sheet form, in conjunction with oils to determine their contribution to dielectric loss after discharge. It is also hoped to investigate the cause of increase in dielectric loss.

The foregoing work forms part of the comprehensive research on high-tension cable by the Detroit Edison Company under the direction of C. F. Hirshfeld. The staff of the research laboratory, and in particular E. W. Spring and J. Sticher, is responsible for the progress recorded.

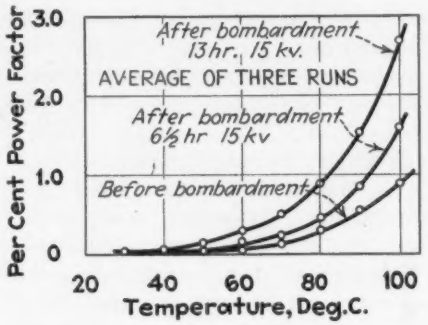


Fig. 4—Power-factor of commercial cable oil rose when ionization occurred at rising temperatures

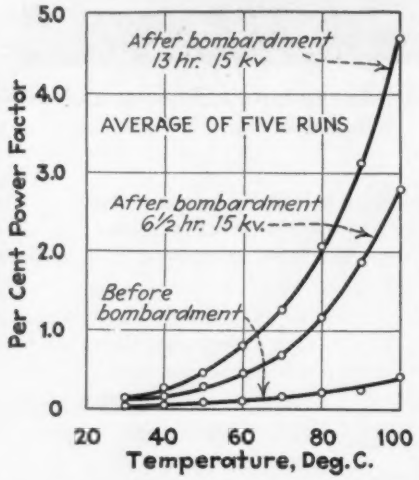


Fig. 3—Increase of power-factor of liquid paraffin after bombardment at rising temperatures

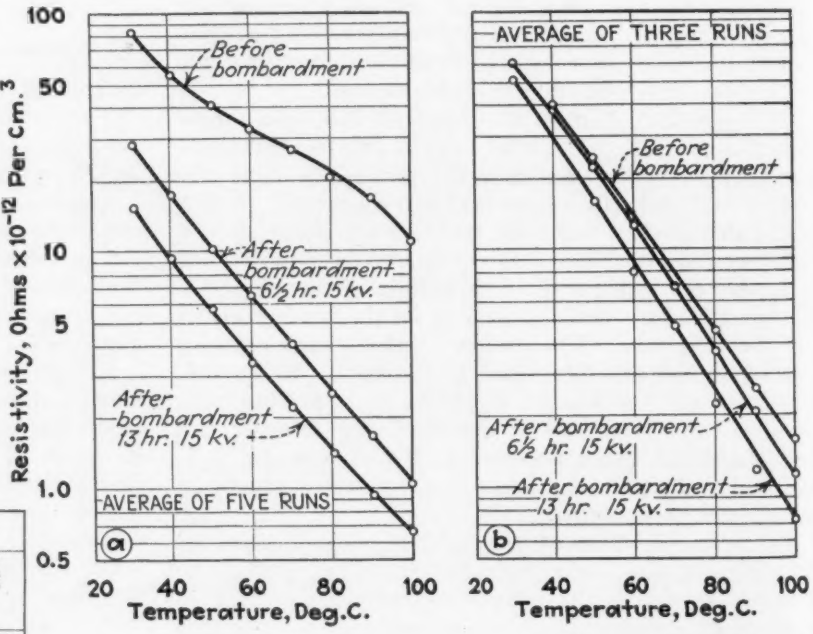


Fig. 5—Resistivity of (a) liquid paraffin and (b) commercial cable oil decreased with bombardment at rising temperatures

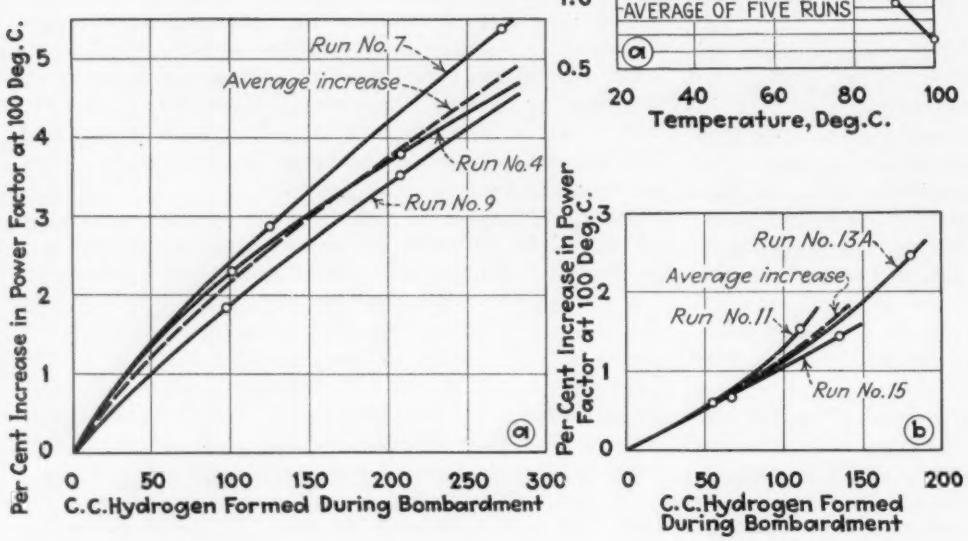
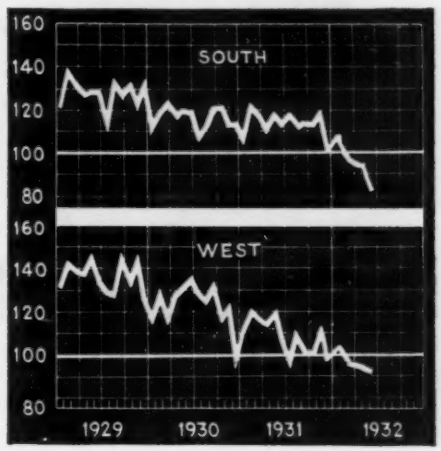


Fig. 6—Power-factor increase against hydrogen formed (a) with liquid paraffin and (b) with commercial cable oil

June Quiet in South and West

In unison with changes in other parts of the country, as reported in last week's issue, industrial activity in the South and West during June fell off somewhat compared with May. For each of these areas, also, the returns on energy consumption in manufacturing plants indicated a striking rise in a single industry, the making of rubber products. This doubled in the South, increased 31 per cent in the West, and in the former at least, rose far above the level of June, 1931. In the South the 7 per cent decrease in the general average was due largely to recessions in three important branches: forest products fell to an unusually low ebb with less than half the activity indicated a year ago; in the stone, clay and glass group most of the figures received were considerably smaller than those for May; food industries were less active than in May, but more so than in the preceding month, and are nearly up to June, 1931. The metal industries slackened. In the West the last-named group advanced, but operations remain 31 per cent slower than last year. Lumber again declined, also the stone, clay and glass group, though some individual reports show a pronounced increase. Chemicals and shipbuilding exceeded and paper and pulp approached last year's figures.



Indices of Industrial Activity in South and West

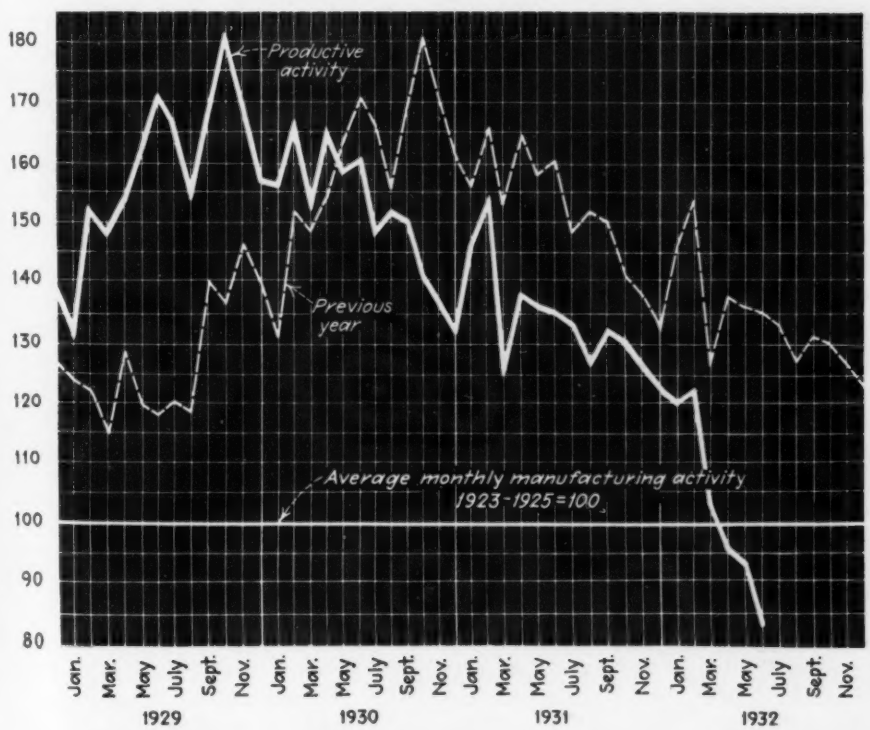
Base: Average Month, 1923-1925 = 100

Industrial Groups....	South June, 1932	South May, 1932	South April, 1932	South Mar., 1932	South June, 1931	West June, 1932	West May, 1932	West April, 1932	West Mar., 1932	West June, 1931
All Industry.....	**83.8**	**90.3***	**89.7***	**92.3***	**114.3**	**91.0**	**94.3***	**96.2**	**97.0**	**108.0**
Chemicals.....	126.0	130.2	117.0	127.4	156.0	85.5	90.1	82.7	81.1	78.0
Food.....	143.8	153.4*	127.8*	116.0*	147.0	112.8	115.3	114.8	116.8	135.4
Iron and Steel.....	60.7	64.8*	76.0	83.7	137.4	.....	.....	.....	.....	.....
Metal working plants...	59.2	64.6*	59.8	60.6	78.8	.....	.....	.....	.....	.....
Metals group.....	60.1	64.7*	69.0	72.6	111.7	41.7	36.2	38.0	42.1	60.8
Forest products.....	29.7	37.6*	44.5	48.4	61.5	105.6	117.0	128.0	130.0	139.0
Paper and pulp.....	117.5	126.0*	134.1	148.0	135.8	128.7	143.0*	134.0*	144.0*	131.0*
Rubber products.....	170.5	83.8	64.3	71.5	105.9	132.0	100.7	99.0	102.5	151.9
Shipbuilding.....	.....	.....	.....	.....	.....	105.0	102.5	100.7	86.4	80.5
Stone, clay and glass....	103.3	124.0	148.9	126.1	173.6	72.8	79.1	96.6	78.0	85.8
Textiles.....	76.2	77.5	85.6	96.2	105.7	.....	.....	.....	.....	.....

*Revision.

▼ ▼ ▼

Electrical Manufacturing Less Active



With comparatively few exceptions electrical manufacturing plants were less active in June than in May, according to returns received by the ELECTRICAL WORLD on energy consumption in that type of establishment. In many instances the decrease was large, the result being an average reduction of 10 per cent when account is taken of the difference in the number of working days in the two months. Compared with the corresponding month of 1931 the returns indicate a decrease of 39 per cent.

In general, the change is in line with what has been occurring in other branches of manufacturing, though less pronounced than in many of them. Both small and large establishments were affected by the change, and in about the same ratio, but the decline in the Middle West was somewhat greater than in the other areas in which electrical manufacturing is important. Since other industries have not yet in general gone on production schedules calling for expanded facilities heavy electrical manufacturing must continue slow, sustained mainly by replacements. In this field there was a moderate decrease.

Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days

Base: Average Month, 1923-1925

Month.....	1929	1930	1931	1932
January.....	131.3	156.2	146.6	120.0
February.....	151.8	165.2	154.3	122.2
March.....	148.3	153.0	126.1	102.9
April.....	154.6	164.9	138.1	95.6
May.....	163.5	158.0	136.7	92.8
June.....	170.5	160.2	135.2	83.1
July.....	166.6	148.5	133.4	.....
August.....	155.4	152.2	126.9	.....
September....	168.8	150.0	132.6	.....
October.....	180.6	140.6	130.4	.....
November....	169.5	137.5	126.9	.....
December....	157.0	132.4	123.5	.....

One of the new Swiss locomotives hauling a freight train. This locomotive (No. 11851) has a maximum tractive effort of 132,000 lb

High-Powered Locomotives for Swiss Railways

By ROBERT F. STOCKAR
Zurich, Switzerland

IN THE development of the Swiss railway traffic two quite different problems manifest themselves: Owing to the very densely populated territory there is a demand for quite frequent but light trains, as in a suburban service but extending right through from one center to the next. For the freight traffic, on the other hand, it is desirable to reduce the number of trains (making them heavier at the same time) in order to reduce the number of locomotives necessary for the movement of a given number of tons and thereby to reduce the number of locomotive crews. This is considered quite an important item, as, for instance, on the largest Swiss railway system, the Swiss Federal Railways, the expenses for the complete personnel make up more than 70 per cent of the total operating expenses.

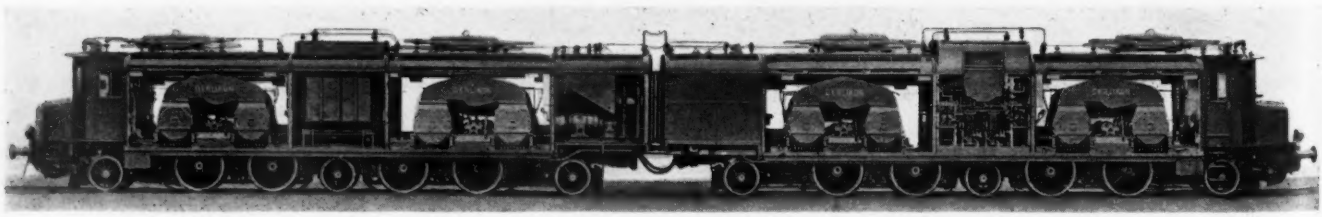
But concentration of freight movement on comparatively few heavy trains was not an easy matter, on account of the steep grades which the bulk of the freight has to pass. On the St. Gotthard line, with grades up to 2.7 per cent, the freight trains having a total weight of 1,400 tons needed, until recently, three locomotives of the 1CC1 (2-6-6-2) type, which were capable of giving a high tractive effort but were not so suitable for express service. For the fast passenger trains locomotives with four driving axles and several different wheel arrangements were used in double heading, but the resulting separation of locomotives for freight and for passenger service was not convenient and the number of locomotives used too large. This has now led to the adoption of a new type of locomotive suitable for freight and for express service and amply sufficient for the present train weights, which are somewhat in excess of those for which the older locomotives had been built.

The new type had to have eight driving axles in order to pull and also accelerate a 750-ton freight train on the 2.7 per cent grade. At the same time it must be capable of handling express trains of 600 tons over the same grade and had to be built for a maximum speed of 100 km. per hour, which is the highest allowed on the Swiss Federal Railways. The highest admissible axle load is 20 tons. On account of the many and sharp curves in the mountains great care had to be taken to give the locomotive good running qualities, and this led to the division of the locomotive in two cabs and to the adoption of a leading axle at both ends and a carrying axle in the middle of each cab. The wheel arrangement of the locomotive is therefore $1B_01B_01 + 1B_01B_01$ (2-4-2-4-2 + 2-4-2-4-2), each of the driving axles being driven individually.

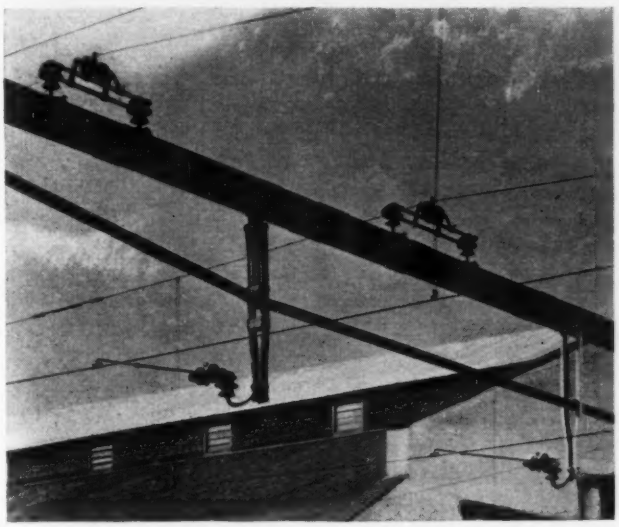
Two locomotives of this type have been built, one by Brown Boveri* and the other by Oerlikon. In the axle

*See "Electrical World," page 419, February 27, 1932; also correction, page 547, March 19, 1932.—[EDITOR'S NOTE.]

One locomotive before sides were inclosed (Unit 11851)



arrangement, the external appearance and the electric control system they are almost alike, while the drive by which the motor couple is transmitted to the driving wheels, the motor capacity and the arrangement of the motors are different. In the first the drive is of the type which has already been used extensively on locomotives of the Swiss Federal Railways and also in other countries and consists of a pinion arranged on one side of the motor and working on a toothed wheel which allows a relative displacement between itself and the running wheels. The second locomotive uses the "universal drive" of the Swiss Locomotive & Machine Works of Winterthur. Here the toothed wheel is fixed in the middle between the running wheels, on a hollow shaft, with a flexible coupling between it and the axle. The toothed wheel receives the motor couple through an intermediate gearing also arranged above the middle of the axle. Above each driving axle there are two motors connected electrically in series, with their pinions turned toward each other and meshing with the large wheels of the intermediate gearing. Each cab of this locomotive contains therefore eight driving motors.



Method of supporting catenary and contact conductor

As the Swiss Federal Railways use single-phase current of $16\frac{2}{3}$ cycles, with 15,000 volts on the contact wire, each cab contains a transformer placed above the center axle. With low adhesion in bad weather, the tractive effort of the locomotive might be insufficient when starting a 750-ton train, up a grade, so a mechanism worked by compressed air has been provided by which about 6 tons of weight can be shifted in each cab from the center axle to the driving axles.

The speed control of both locomotives is effected, as on all modern straight single-phase locomotives by varying the voltage which is impressed on the motors. Until recently this adjustable voltage has always been obtained from taps on the low-tension transformer winding, but on these locomotives the taps, following a Brown Boveri idea, are arranged on the high-tension winding, with the result that the step switch can be built for much smaller currents.

Both locomotives are equipped for regenerative braking according to the Oerlikon system, which involves connecting the driving motors as shunt generators and inserting a choke coil in the armature circuit. The electric braking power is sufficient to bring the whole train down to standstill without using the air or the hand brake.

The major data of these locomotives are given in the accompanying table below.

Wheel arrangement	$1B_o1B_o1 + 1B_o1B_o1$ (2-4-2-4-2 + 2-4-2-4-2)	
Number of locomotive	11801	11851
Builder of electric part	Brown Boveri	Oerlikon
Builder of mechanical part	Winterthur	Winterthur
Length over bumpers (meters)	34,0	34,0
Wheelbase of one cab (meters)	12,5	12,5
Wheelbase of locomotive (meters)	29,0	29,0
Diameter of driving wheels (meters)	1,61	1,35
Gear ratio	1:2.57	1:3.47
Number of motors	8	16
One-hour output of motors, measured at motor shaft (hp.)	7,500	8,800
Continuous output of motors, measured at motor shaft (hp.)	7,000	8,300
Speed at one-hour output (km. per hour)	59	62
Speed at continuous output (km. per hour)	61	65
Maximum speed (km. per hour)	100	100
Maximum tractive effort (kg.)	50,000	60,000
Weight of locomotive (metric tons)	243	244

These capacities are far in excess of anything which has until now been reached in Europe. So far the highest-powered European locomotive was the high-speed 5,400-hp. locomotive running on the electrified line Culoz-Modane of the Paris-Lyon-Mediterranean Railway, having the wheel arrangement $2C_oC_o2$ (4-6-6-4), and it is still the most powerful one-cab locomotive. Among the American locomotives the power record is now held by the three-cab locomotives of the Virginian Railway, the one-hour capacity of which is about 7,200 hp., at a speed of 45 km. per hour. The Swiss locomotive No. 11851 is therefore, now, the most powerful locomotive in the world.

Both locomotives are in trial service on the St. Gotthard line and it will depend on the results which type will be ordered in larger numbers.

▼

Changing Two-Wire to Three-Wire Meters

Many utility companies are finding that with the accelerated sales of ranges and other large appliances two-wire meters are accumulating in their stocks, while new three-wire meters are replacing them. When the two-wire meters, thus piled up, represent an actual excess over the need for that type, it may be economical to convert them into three-wire. In the case of the Toledo Edison Company this was found to be the case to the extent of 1,800 conversions in 1931 and of a rate of 100 per month this year. The change is not difficult, consisting merely of replacing current coils and revising or changing registers and of shifting terminal connections. The total cost of a three-wire meter thus produced is, of course, more than the price of a new meter. But part of that cost is in idle or lost investment in two-wire meters, which thus can be salvaged and the actual cash outlay per meter is less than the price of a new meter.

Cutting the Cost of Tower Foundations

"The greater part of the cost of a double-circuit high-voltage transmission line is determined by the insulators and conductors, amounting to nearly 50 per cent on the average line if erection and overhead expenses are prorated. A very large part of this is in conductor material." So says the transmission engineer of a holding company which has operating properties in various parts of the United States. In explanation of this apparently surprising statement, he says that his comments are based on an analysis of nine double-circuit lines of various voltages—66 kv., 110 kv. and 132 kv.—with No. 3/0 conductors. On the lines studied the right-of-way cost was low ($400 to $500 per mile). Overhead charges, including interest, general construction and construction equipment, constituted 25 per cent of the total cost and was prorated. Conductors and insulation jointly constituted 32 to 45 per cent of the total. When this analysis was made copper cost 17¼ cents per pound and erection of copper cost 2¼ cents per pound, or a total of 19¼ cents per pound.

With so large a proportion, determined by load or expected load, it has been concluded that economy and reliability depend largely on careful attention to numerous small items. This engineer continues:

We have recently been giving a great deal of attention to the tower foundation. The installation of the footings is a large percentage of the total field labor, generally about 25 per cent. In rough country this item has amounted to 50 per cent of the labor cost. In such country it has been found that the grading and deep holes required to locate a square tower on steep slopes are often a large part of the footing cost. On one line in particular grading amounted to 25 per cent of the total excavation. This extra work, which does not increase the reliability of the construction, can be in a large measure eliminated by providing simple light-weight extensions which will permit setting the tops of the individual footings at approximately the ground surface.

Concrete footings are generally not economical on account of the high cost of hauling material and water to the tower sites. Our practice has been more and more to use steel grillages even on the heavy angle and dead-end towers. A few years ago a line was constructed on which both concrete and steel grillage footings were furnished as alternates for the heavy angle towers. The actual cost analysis of this job showed that the steel grillage footings could be installed for 30 to 50 per cent of the cost of concrete footings of about the same strength.

Both for economy and reliability it is essential to have all the possible information on soil conditions before the designs are completed. As an example, on a recent line built in————it was found necessary to increase the size of the footings nearly 50 per cent for a large portion of the line. Earth borings indicated that considerable sections were in a volcanic ash soil weighing less than 50 lb. per cubic foot.

If fairly accurate information on footing conditions can be obtained and careful supervision of the installation assured, large economies can be effected in the excavation and footing costs by providing more than one type. Usually the major part of a line is in good hard soil and usually the high cost of construction is caused by expensive excavation in this hard material. In such locations a small footing is adequate.

Poor footing conditions are usually caused by poor drainage and lateral support is quite important. Generally it is possible to so design the standard footing that additional area and better lateral support can be obtained by a simple addition to the standard construction.

Special types of footings are often economical. We have found that the "Malone" footing can be installed at a great reduction in cost over the usual type in deep heavy clay soil. In addition to the saving in cost this footing was much more satisfactory than the steel grillage, which requires several months' setting before the back-fill consolidates and gives a reliable foundation.

▼

READERS' FORUM

The "A" System Facilitates Common Neutral Practice

To the Editor of the ELECTRICAL WORLD:

In the use of the common neutral wire we are today concerned with the increase of primary or/and secondary line voltage and the conversion from delta-delta or star-delta to delta-star or star-star.

To obtain a higher line voltage a change in the transformer system connections may be made when the primary lines and/or the secondary mains have become overloaded, when a relatively large additional load and/or a lengthy line extension must be cared for or when the existing transformers have become fully loaded or overloaded.

A changeover from delta-star to star-star will involve an extra cost for tertiary delta windings, etc., and perhaps a less happy condition than formerly as all the circuits connected thereto must be converted in one operation because of the resulting phase displacement.

For a change from delta-delta to star-delta or delta-star it is ordinarily impossible to take advantage of the common neutral because there is no true neutral on the delta side. And where a star-star connection already exists the system will already have reached its ultimate limit of voltage expansion and usefulness of the transformers.

The question of a suitable flexible system for future expansion and the general use of a common neutral wire appears to rest with that symmetrical three-phase system of connections offering delta-star or star-delta on the primary as also on the secondary sides of the system, using the three-phase windings. And the nearest practical approach to such a system is that known as the "A" three-phase, four-wire system (where three-phase windings are used), which offers a true neutral on both primary and secondary, increased line voltage without phase displacement, decreased and symmetrical voltage stresses to earth, compared with the usual method of earthing the delta, and means for a gradual changeover, etc.

Not unlike the "V" system, which enjoys such a wide use, the "A" system also has its relative disadvantages. Nevertheless, for system conversion to a higher line voltage, to secure the advantage of a true neutral and symmetrical and minimum voltage stresses to earth, to obtain a more general use of the common neutral, the need for converting gradually, and the desire to make use for the higher voltage of every discarded transformer (including those recently operating star-star) the "A" system offers a usefulness worthy of closer consideration by operating companies, engineers and managers.

London, England. WILLIAM T. TAYLOR.

Men of the Industry

Okonite Executives Assume New Duties

H. Durant Cheever, formerly president of the Okonite Company, has been made chairman of the board and Frank C. Jones, formerly vice-president and

H. D. Cheever

general manager, has been named president to succeed him with the title of president and general manager. Both men have long been members of the Okonite organization. Mr. Cheever's connection covers a period of 44 years and started following his graduation from Harvard University in 1888 when he joined the New York staff. Mr. Jones, following discharge from military service after the World War, en-

F. C. Jones

tered the factory of the Okonite Company at Passaic. With his election as treasurer he was transferred to the New York office, subsequently becoming vice-president and general manager. He was educated at the Noble and Greenough School at Boston and Harvard University. He is chairman of the power cable group of the National Electrical Manufacturers' Association.

R. W. Alexander, formerly connected with Allied Engineers, Inc., and later with the Consumers Power Company, in Jackson, Mich., has resigned his position with the latter company to join the Anaconda Wire & Cable Company, New York. While with Allied Engineers, Mr. Alexander was connected with system planning. He has served on the power systems engineering committee of the National Electric Light Association.

•

Col. Edward C. Rose, president of the First Mechanics National Bank of Trenton, will become a vice-president of the Public Service Corporation of New Jersey October 1. Colonel Rose, who will carry the title of vice-president in charge of the southern division, was elected a director of the corporation more than a year ago. He will resign from the presidency of the bank upon accepting this new executive position. In the course of a varied career he has been identified with public utility, banking, publishing and military enterprises.

•

Wirt S. Scott, special representative of the Westinghouse Electric & Manufacturing Company, Mansfield, Ohio. was recently awarded the professional degree of electrical engineer by Ohio State University as a tribute to the work by which he has distinguished himself in the engineering field. He is recognized as a leading authority in this country in the economic study and application of electric heating for industrial and commercial processes and is one of the best-known technical writers and lecturers in the United States. Mr. Scott has been engaged for the past twenty years in electrical heating work.

▼

OBITUARY

R. A. Fessenden

Reginald A. Fessenden, noted inventor in the field of electrical communication and a pioneer in radio development and research, died suddenly July 22 at Hamilton, Bermuda. He was born 65 years ago at Milton, Quebec. From 1886 to 1887 he headed the Whitney Institute in Bermuda; then became head chemist at the laboratories of Thomas A. Edison in New Jersey, where he served for three years, and subsequently joined the electrical engineering organization of the Westinghouse Electric & Manufacturing Company. For a time he was professor of electrical engineering at Purdue University and the University of Pittsburgh. For many years he made his headquarters at Chestnut Hill, Mass., devoting his time to research, and approximately 300 of his inventions applied to the field of radio telephony. Many hundreds of patents bearing upon electrical communication were taken out by him. He was much in demand as a consultant and was repeatedly and often successfully involved in patent litigation suits involving large sums. At one time he was an executive of the Submarine Signaling Corporation.

▼

Austin E. Greene

Austin E. Greene, for many years sales engineer for the Condit Electrical Manufacturing Corporation, Hyde Park, Mass., and one of the best known figures in the New England electrical trade, died July 20 at the age of 62. Mr. Greene was born in London, England, and came to this country when a boy of 16. He was associated with the Boston Electric Light Company in the early nineties in electrical station construction work and engaged in mine laying in Boston Harbor during the Spanish War. He left the Boston company upon its merger with the Boston Edison company at the beginning of the present century and joined the organization of Sears B. Condit at Boston, beign occupied in electrical construction for some years, later taking up sales work for the Condit electrical manufacturing organization. For the past 12 years Mr. Greene had devoted most of his time to the Edison Electric Illuminating Company of Boston on behalf of his own company and was highly regarded by the executive and engineering staff of that utility.

▼

H. O. Swoboda, consulting electrical and mechanical engineer, died June 30 in his sixty-third year in Pittsburgh, Pa., after a short illness. A native of Germany, Mr. Swoboda came to this country at an early age. In 1910 he became associated with the Westinghouse Electric & Manufacturing Company as superintendent of the electrical department. He then organized H. O. Swoboda, Inc., in 1919, of which company he was president and treasurer until the time of his death. In the electrical industry he was a recognized authority on power plant work and had devoted considerable time and research to electric heating. He designed and developed numerous electrical inventions for which he received United States and foreign patents and made numerous contributions to scientific journals. He was a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, the American Society for Steel Treating and a registered professional engineer of the State of Pennsylvania.

New Equipment Available

Boric Acid Fuse Extinguishes Arcs

A fuse which breaks 20,000 amp. at 13,200 volts without involving any difficulty is announced by the Westinghouse Electric & Manufacturing Company. In the center of a thick-walled cylinder of solid boric acid is a plunger, which would be withdrawn deep into its hold by a spring were it not held forward by the fuse wire which serves as one terminal. When the fuse melts the arc is drawn down into the boric-acid hole and elicits an outrush of water vapor which instantly extinguishes it.

▼

Oil Circuit Breaker of High Interrupting Capacity

A new oil circuit breaker of relatively high interrupting capacity, known as Type Y 100, for indoor, high-amperage circuits of 7,500 volts or less, is announced by the Condit Electrical Manufacturing Corporation, Boston, Mass. The breaker is of the inclosed mechanism type, with all poles in one tank, and offers the features of non-oil-throwing, high speed of operation, small space requirements and provision for venting. An oil and gas separator minimizes the discharge of oil from the breaker, yet provides an efficient release for the gas pressure. A valve automatically resets after the relief has been obtained and seals the breaker arm from intake of moisture.

The breaker may be furnished manually or electrically operated for 2,000 and 3,000 amp. at 7,500 volts, with an estimated interrupting capacity of 100,000 kva.

•

A NEW TYPE OF HEALTH LAMP designed so that it fits into any lighting socket on any lighting line and does not require transformers or other additional apparatus, known as the Sirian ultra-violet lamp, has been announced by the Arcturus Radio Tube Company, Newark, N. J. It replaces any incandescent bulb and operates without noise or dirt. The lamps are made in 60, 100, 150 and 300-watt sizes.

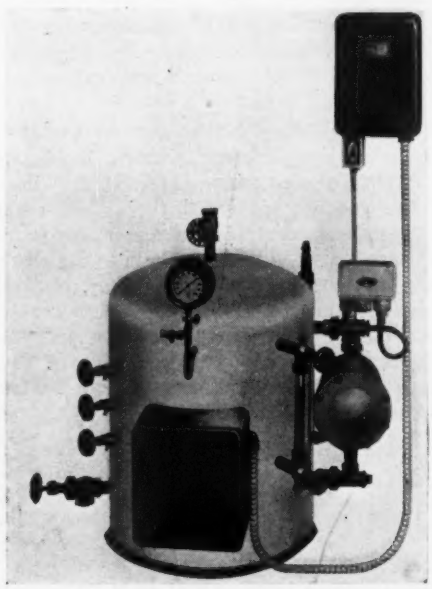
•

A NEW LINE OF TERMINAL BLOCKS which will do all that the old style terminal boards and isolation switches can, plus providing a ready means for cutting instruments into the circuit, is announced by the States Company, Hartford, Conn. Some of the advantages claimed for these blocks are: To cut an indicating instrument or artificial load into circuit simply attach the leads to both terminals and drop the link; the link clearly indicates "closed" or "open" position, etc.

▼

Process Steam Supplied Economically

Countless industries requiring process steam in small or moderate volumes at pressures of from 200 lb. downward will be interested in a new line of electrically heated full-automatic steam boilers being marketed by the Commonwealth Electric & Manufacturing Company, South Boston, Mass. Six standard models are available, ranging from 7.5 kw. to 90 kw. in rating, the operating voltages being either 110-125 or 220-250. The boilers conform to the A.S.M.E. and



Massachusetts codes. The field of application includes installations where main boiler plants must be run at low load to deliver process steam outside the normal heating season, where small amounts of steam are needed at extra high pressure, where process steam is required infrequently at points distant from the main boiler, where explosive atmospheres debar flame heating, where local fuel-fired boilers are objectionable, where hydro-electric energy is economically available and where all-night process steam is wanted. In general, the equipment is competitive with fuels where the energy rate is 3 cents per kilowatt-hour or less. General Electric immersion and switching units are used with this equipment.

Automatically Primed Centrifugal Pumping Unit

A new self-contained, automatically primed centrifugal pumping unit having many advantages is announced by the Worthington Pump & Machinery Corporation, Harrison, N. J. The unit comprises an electrically driven high-efficiency ball-bearing centrifugal pump, mounted, with its motor, on a fabricated steel bedplate, together with a monobloc priming unit of the wet vacuum type, controlled by an electric pressure switch. Some of the advantages claimed for this unit are: No compromise necessary on the size and type of pump for a particular service, a priming unit that operates only when needed and the use of no more power and no more space than a non-priming unit, etc.

▼

Water Heater Fuse Interrupts Circuit

A safety heat fuse which is a positive temperature protection and does not release heated water, but cuts off the electric current in an emergency before the water becomes dangerously hot, is announced by the Hynes & Cox Electric Corporation. It then keeps the current shut off until the trouble has been corrected and a new link installed in the fuse, it is claimed.

Some of the advantages claimed for it are: It prevents waste of water; prevents waste of electricity; prevents flooding of kitchen or cellar; is located at the correct position where it is affected by the hottest water in the tank; is not affected by any variations in water supply pressure, etc.

▼

Laminated Resinous Material May Be Readily Fabricated

A new laminated resinous material known as "Dilecto Uf" has been announced by the Continental-Diamond Fibre Company. It is combined with either paper or fabric, molded between plates under heat and pressure, and is converted into a hardened infusible product, susceptible to any desired coloration. It differs, however, in its combination of valuable properties.

As it appears from the presses, "Dielecto Uf" occurs in sheets, tubes and rods, colored in any translucent or opaque shade, and with a glossy finish. The surface can be sanded and the desired shade can be fabricated by cutting or machining. Up to and including ½ in. thick, it can be punched hot with a preheating temperature not in excess of 120 deg. C. Preheating is carried on only until the piece is thoroughly warm.